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This stunning image from NASA's Hubble Space Telescope reveals a dramatic interplay of light and shadow in the Egg Nebula, sculpted by freshly ejected stardust. Located approximately 1,000 light-years away in the constellation Cygnus, the Egg Nebula features a central star obscured by a dense cloud of dust — like a “yolk” nestled within a dark, opaque “egg white.” Only Hubble's sharpness can unveil the intricate details that hint at the processes shaping this enigmatic structure.

It is the first, youngest, and closest pre-planetary nebula ever discovered. (A pre-planetary nebula is a precursor stage of a planetary nebula, which is a structure of gas and dust formed from the ejected layers of a dying, Sun-like star. The term is a misnomer, as planetary nebulae are not related to planets.)

Link: <https://science.nasa.gov/missions/hubble/nasas-hubble-captures-light-show-around-rapidly-dying-star/>

# Bulletin of The Indian Association of Physics Teachers

<http://www.indapt.org.in>

The Bulletin is the official organ of the IAPT. It is a monthly journal devoted to upgrading physics education at all levels through dissemination of didactical information of physics and related areas. Further, the Bulletin also highlights information about the activities of IAPT. All communications should be addressed to:

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## *Editorial*

### **Important Contributions of Bharatiya Physicists**

The recent lecture delivered by **Dr. P. C. Deshmukh**, eminent theoretical atomic physicist and Vice President of the Indian Association of Physics Teachers, at G. H. Rasoni College of Engineering (GHRCE), Nagpur, was more than an academic discourse—it was a reaffirmation of India's deep and enduring engagement with the global evolution of physics. Organized under the aegis of IAPT, the lecture served as an intellectual bridge connecting historical insight with contemporary scientific responsibility encouraged me to add a few more contributions to complete the coverage.

Prof. Deshmukh presented a comprehensive and scholarly overview of the monumental contributions made by Bharatiya physicists across classical, modern, nuclear, space, and contemporary theoretical physics. His exposition was not merely chronological; it was conceptual—demonstrating how ideas born in India have shaped the theoretical and technological architecture of modern science.

#### **The Foundational Giants**

The “Big Three” whose contributions transformed global physics. C. V. Raman's discovery of the Raman Effect in 1928 established the phenomenon of inelastic scattering of light, laying the foundation of Raman spectroscopy—today indispensable in materials science, chemistry, biology, and nanotechnology. His Nobel Prize in 1930 signaled the arrival of Indian experimental physics on the world stage.

Satyendra Nath Bose's formulation of Bose–Einstein statistics introduced an entirely new class of particles—bosons—and redefined quantum statistical mechanics. His collaboration with Einstein ultimately led to the prediction, and decades later the realization, of the Bose–Einstein Condensate, one of the most striking macroscopic manifestations of quantum phenomena.

Meghnad Saha's ionization equation provided

astrophysics with a quantitative tool to interpret stellar spectra, thereby linking laboratory physics with cosmic observation. Through Saha, thermodynamics found its way into the heart of stellar evolution theory.

#### **Nuclear Science, Space, and Astrophysical Frontiers**

Prof. Deshmukh then traced the consolidation of scientific institutions and theoretical depth through figures such as Homi J. Bhabha, whose work on electron–positron scattering (Bhabha scattering) and visionary leadership led to the establishment of TIFR and BARC, shaping India's nuclear research trajectory.

Subrahmanyan Chandrasekhar's derivation of the Chandrasekhar Limit ( $\sim 1.44$  solar masses) fundamentally altered our understanding of stellar structure and collapse, providing the theoretical groundwork for white dwarfs, neutron stars, and black holes. His Nobel Prize in 1983 recognized a contribution that forever changed astrophysics.

Vikram Sarabhai extended cosmic ray research into a national vision, laying the foundations of ISRO and embedding space science into India's developmental aspirations.

#### **Modern and Contemporary Thought**

In modern theoretical and applied domains, G. N. Ramachandran's Ramachandran Plot revolutionized molecular structure analysis. Ashoke Sen strengthened string theory through profound insights into S-duality. Amal Kumar Raychaudhuri's Raychaudhuri Equation became central to singularity theorems in general relativity which is remarkable.

E. C. G. Sudarshan's V–A theory reshaped weak interaction physics. Jagadish Chandra Bose pioneered wireless communication experiments even before Marconi's demonstrations, while bridging physics and plant physiology. Anna Mani strengthened India's meteorological instrumentation, critical for climate

science and renewable energy systems.

Contributions by Raja Ramanna, Devendra Lal, Piara Singh Gill, K. S. Krishnan, Bibha Chowdhuri, and Debendra Mohan Bose further illustrated India's early engagement with magnetism, cosmic rays, and particle detection techniques.

### **Quantum Algorithms and Photonic Revolutions**

Importantly, Prof. Deshmukh extended the narrative into 21st-century physics. Lov Grover's quantum search algorithm demonstrated a quadratic speed-up over classical search methods, providing one of the earliest concrete proofs of quantum computational advantage. Today, Grover's algorithm stands as a cornerstone of quantum information science.

Similarly, Narinder Singh Kapany, widely regarded as the “Father of Fiber Optics,” transformed the principle of total internal reflection into a technological

revolution. Modern global telecommunications infrastructure—high-speed internet, medical imaging, optical sensing—rests upon foundations he helped establish.

### **A Pedagogical Responsibility**

The contributions of Bharatiya physicists are not peripheral footnotes but central chapters in the evolution of global science.

As we align curricula with the spirit of NEP and seek meaningful integration of Indian Knowledge Systems (IKS), these scientific achievements offer authentic and rigorous content. They remind us that intellectual self-reliance is not rhetoric—it is a historical reality.

The legacy outlined in this lecture compels us to nurture future physicists who will not merely inherit this tradition but extend it.

**S.W. Anwane**

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## Physics News

### Neutron scattering helps clarify magnetic behaviour in altermagnetic material

RuO<sub>2</sub> has drawn global attention as a possible "altermagnetic" material, a newly predicted class of materials that could enable faster, more energy-efficient computing technologies. One piece of evidence often cited in support of altermagnetism is magnetic behavior known as exchange bias. When thin films of RuO<sub>2</sub> are grown in intimate contact with a ferromagnet such as iron (Fe), researchers observe a shifted magnetic hysteresis loop, a signature commonly associated with hidden magnetic order such as antiferromagnetism. The work is part of an ongoing NRL research program exploring altermagnetism and related phenomena. The team is now investigating how strain and compression may influence magnetic states in RuO<sub>2</sub> and other candidate materials. By carefully separating intrinsic material properties from interfacial chemistry, the researchers say they hope to provide a clearer framework for evaluating future altermagnetic candidates. In emerging fields, progress often depends not just on finding new effects, but on understanding what truly causes them.

**Read more at:** <https://phys.org/news/2026-02-neutron-magnetic-behavior-altermagnetic-material.html>

**Original Paper:** ACS Applied Materials & Interfaces (2026). DOI: 10.1021/acsami.5c20863

### Quantum trembling: Why there are no truly flat molecules

Traditional chemistry textbooks present a tidy picture: Atoms in molecules occupy fixed positions, connected by rigid rods. But quantum physics tells a different story. In reality, nature resists rigidity and forces even the simplest structures into the third dimension. Researchers led by Professor Reinhard Dörner of the Institute for Nuclear Physics at Goethe University have now determined the precise spatial structure of the "flat" formic acid molecule using an X-ray beam from the PETRA III synchrotron radiation source at the DESY accelerator center in Hamburg. In chemistry, two such chiral forms—so-called enantiomers—can have completely different effects: While one form of a molecule may act as a medicine, its mirror image may be ineffective. Normally, this handedness arises from the fixed structure of a molecule. This means that handedness—an important property of life—does not arise here from the molecule's static blueprint, but solely from the incessant trembling in the quantum world.

**Read more at:** <https://phys.org/news/2026-02-quantum-flat-molecules.html>

**Original Paper:** Physical Review Letters (2026). DOI: 10.1103/bvqj-pm3n

### Machine learning algorithm fully reconstructs LHC particle collisions

The CMS Collaboration has shown, for the first time, that machine learning can be used to fully reconstruct particle collisions at the LHC. This new approach can reconstruct collisions more quickly and precisely than traditional methods, helping physicists better understand LHC data. Each proton-proton collision at the LHC sprays out a complex pattern of particles that must be carefully reconstructed. The new CMS machine-learning-based particle-flow (MLPF) algorithm approaches the task fundamentally differently, replacing much of the rigid hand-crafted logic with a single model trained directly on simulated collisions. When benchmarked using data mimicking that from the current LHC run, the performance of the new machine-learning algorithm matched that of the traditional algorithm and, in some cases, even exceeded it. The new algorithm also allows a collision to be fully reconstructed far more quickly than before, because it can run efficiently on modern electronic chips GPUs. By teaching detectors to learn directly from data, physicists are not just improving performance, they are redefining what is possible in experimental particle physics.

**Read more at:** <https://phys.org/news/2026-02-machine-algorithm-fully-reconstructs-lhc.html>

**Original Paper:** arXiv (2026). DOI: 10.48550/arXiv.2601.17554

**Soumya Sarkar**  
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## March: This Month in the history of Physics

History shows that March has often marked the formal unveiling and consolidation of transformative advances in physics.

### Volta and the Birth of the Electric Battery

In the late eighteenth century, electricity fascinated scientists but had little practical use, as devices like Leyden jars produced only brief sparks. A major breakthrough came on **March 20, 1800**, when Alessandro Volta described the voltaic pile—the first device to generate a steady electric current—

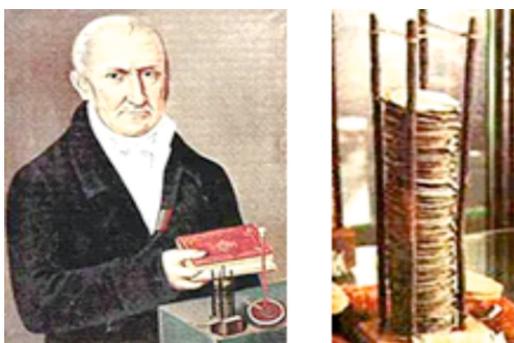


Fig.1: Alessandro Volta (L); A Voltaic Pile (R).

marking the birth of the modern battery. This invention arose from Volta's debate with Luigi Galvani and showed that electricity is produced by the contact of different metals, not by animal tissue. To prove his idea, Volta stacked alternating discs of zinc and silver, separated by cloth soaked in saltwater. When the top and bottom of this stack were connected by a wire, a continuous current flowed. Unlike earlier electrical devices, the strength of the current could be increased simply by adding more metal pairs. This clear demonstration showed that electricity could be generated chemically, without any biological material, and could be controlled and sustained. Volta himself compared the device to an “artificial electric organ,” emphasizing that it mimicked nature without depending on living tissue.

The impact of Volta's March 1800 discovery was immediate and profound. The battery soon enabled the decomposition of water, laying the foundation of electrochemistry, and became a crucial tool in studies of electromagnetism, including the experiments of Michael Faraday. It later powered early technologies such as telegraphs, transforming electricity from a

laboratory curiosity into a practical resource. For this achievement, Volta's name is preserved in the SI unit of electric potential, the volt, marking March 20, 1800 as a defining moment in physics and technology.

### Dawn of Global Communication: The Telephone

A major link between physics and everyday life was made on **March 7, 1876**, when Alexander Graham Bell patented the telephone (U.S. Patent No. 174,465). Rather than discovering new laws, Bell applied established principles of wave motion, acoustics, and electromagnetism to create a practical system for transmitting the human voice over long distances.

At its heart, the telephone is based on the physics of sound waves. When a person speaks, sound is produced as pressure waves in air. In the telephone transmitter, these pressure waves strike a thin diaphragm, causing it to vibrate in exactly the same pattern as the sound. These mechanical vibrations are then converted into electrical signals by changing an electric current in a circuit. Importantly, the variations in the current follow the same time pattern as the original sound waves. At the receiving end, this process is reversed: the changing electric current produces varying electromagnetic forces that move another diaphragm, recreating the original sound. This elegant chain - from sound waves to electrical signals and back to sound - demonstrated that information can be preserved while changing its physical form.

The importance of Bell's March 1876 patent lies in showing that information can be transferred between different physical forms - mechanical, electrical, and later electromagnetic. This idea became central to modern communication, signal processing, and digital technology, making the telephone a key example of how basic physical laws lead to transformative technologies.

### Becquerel's Experiment and Radioactivity

In **March 1896**, French physicist Antoine Henri Becquerel discovered radioactivity, revealing a previously unknown property of matter. Although it is often described as accidental, the discovery resulted from a careful preparation and favourable circumstances. Motivated by Wilhelm Röntgen's discovery of X-rays, Becquerel tested whether

phosphorescent materials could emit similar radiation by placing uranium compounds on covered photographic plates.



Fig. 2: Becquerel in his Laboratory

The decisive moment came when poor weather intervened. Unable to expose the crystals to sunlight, Becquerel stored the prepared photographic plates in a dark drawer. When he later developed them—expecting little or no effect—he instead observed strong, sharply defined images. The uranium compound had exposed the plates without any prior illumination, demonstrating that the emission was neither reflected light nor phosphorescence. This observation overturned prevailing assumptions in physics: matter itself, without external stimulation, could spontaneously emit penetrating radiation. Becquerel soon confirmed that the effect was intrinsic to uranium, persistent over time, and independent of chemical form. In modern terms, the phenomenon arose from nuclear decay processes - primarily alpha and beta emission -though these mechanisms would only be understood years later.

Becquerel's March 1896 discovery provided the first clear evidence that atoms contain internal energy, overturning classical ideas of atomic stability. It laid the foundation for nuclear physics and inspired the work of Marie and Pierre Curie, leading to the development of nuclear science and the SI unit of radioactivity, the becquerel (Bq).

### Discovery of the Top Quark at Fermilab

On **March 2, 1995**, a major milestone in modern physics was announced at Fermilab, where the CDF and D0 collaborations reported the discovery of the top quark, the last missing member of the quark family predicted by the Standard Model. After the bottom quark was discovered in 1977, theory required the existence of its partner, the top quark, but its

unexpectedly large mass placed it beyond the reach of earlier accelerators. By the late 1980s and early 1990s, indirect evidence pointed to the heaviest known fundamental particle (top quark with a mass of about 173 GeV), making its discovery a critical test of the Standard Model.

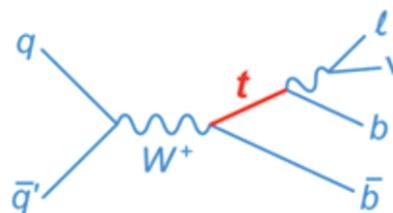


Fig. 3: Schematic diagram of single top-quark production in  $p - \bar{p}$  collisions. Credit: D0 Collaboration.

The experimental challenge was hard in many aspects. We know that protons and antiprotons are made of quarks, antiquarks, and gluons. When a proton and an antiproton collide, they can produce a top quark in more than one way. In one process, a quark ( $q$ ) from the proton and an antiquark ( $\bar{q}$ ) from the antiproton combine to form a  $W$  boson ( $W^+$ ), which then decays into a top quark ( $t$ ) and an anti-bottom quark ( $\bar{b}$ ). In another process, a gluon interacts with a quark. The quark emits a  $W$  boson, while the gluon produces a bottom quark ( $b$ ) and an anti-bottom quark ( $\bar{b}$ ). The  $W$  boson then interacts with the bottom quark to create a single top quark. The top quark is extremely short-lived and decays almost immediately. A common decay process produces a bottom quark, a lepton ( $l$ , such as a muon), and a neutrino ( $\nu$ ). Because the top quark cannot be seen directly, scientists identify it by carefully detecting and analyzing these decay products.

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## Integrating CERN-Based Learning into the Physics Classroom: Reflections from the International High School Teacher Programme 2025

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**Abstract** The CERN International High School Teacher (HST) Programme offers a unique professional development platform that immerses educators in contemporary particle physics research, advanced detector technologies, and international STEM pedagogy. This article presents a detailed reflection on my participation in the 2025 cohort,

### Introduction

Modern physics—particularly particle physics, accelerator science, and quantum phenomena—remains underrepresented in secondary education despite its foundational role in contemporary scientific and technological advances. The CERN HST Programme addresses this gap by offering teachers an immersive experience at one of the world's most significant scientific institutions. Participants engage with active research environments, interact with scientists, and explore pedagogical strategies grounded in inquiry and conceptual understanding.

My participation in the 2025 cohort was both intellectually and personally transformative. The opportunity to stand inside the ATLAS and CMS detector caverns, observe superconducting magnet tests, and build a functioning cloud chamber provided a depth of experiential learning that reshaped my pedagogical approach. These experiences demonstrated that modern physics is not inherently inaccessible to school students; rather, it requires thoughtful translation into classroom-friendly formats grounded in observation, modelling, and inquiry.

### The process of enrichment for the participants at CERN

The insights presented in this article are derived from a systematic reflective process undertaken before, during, and after participation in the CERN International High School Teacher (HST) Programme.

The methodology integrates multiple sources of evidence to ensure that the reflections are both authentic and pedagogically grounded.

- I. Daily Reflective Journaling Throughout the program.** I kept a structured journal documenting scientific observations, conceptual clarifications, and pedagogical insights. These entries captured immediate reactions to lectures, laboratory demonstrations, and interactions with scientists, providing a rich qualitative record of evolving understanding.
- II. Collaborative Dialogue with International Educators.** Regular discussions with fellow teachers from diverse educational systems provided comparative perspectives on teaching modern physics. These dialogues helped contextualize CERN's pedagogical approaches within broader global practices and informed the adaptation of strategies for my classroom.
- III. Systematic Observation Notes.** Detailed notes were recorded during detector visits, experimental demonstrations, and pedagogical workshops. These observations served as primary data for analysing how complex scientific concepts are communicated through visual, experiential, and model-based methods.
- IV. Post-Program Classroom Implementation.** Following the program, selected CERN-inspired activities—such as cloud chamber construction, concept mapping, and simplified detector simulations—were implemented with secondary students. These classroom trials provided practical insights into feasibility, student engagement, and conceptual impact.
- V. Informal Student Feedback.** Student responses were gathered through reflective prompts, group

discussions, and open-ended conversations. Their feedback provided valuable evidence of learning outcomes, misconceptions, and affective responses to modern physics activities.

VI. Together, these reflective components form a robust methodological framework that grounds the article's conclusions in both authentic scientific inquiry and real-world classroom practice.

### Scientific Insights from the CERN Experience

One of the most profound experiences during the program was descending into the underground caverns housing the ATLAS and CMS detectors. The sheer scale and complexity of these instruments—layered trackers, calorimeters, and muon chambers—offered a tangible representation of how the Standard Model is experimentally validated.

Observing these detectors firsthand clarified several key principles:

- **Charged particles** follow curved trajectories in magnetic fields, enabling the determination of momentum and charge.
- **Calorimeters** quantify particle energies by measuring controlled energy deposition.
- **Muon chambers** identify highly penetrating particles that pass through other detector layers.

These observations provided a powerful conceptual bridge between textbook physics and real-world experimentation. They also reinforced the pedagogical value of teaching conservation laws, energy-loss mechanisms, and particle identification through visual and experiential analogies rather than formulaic abstractions.



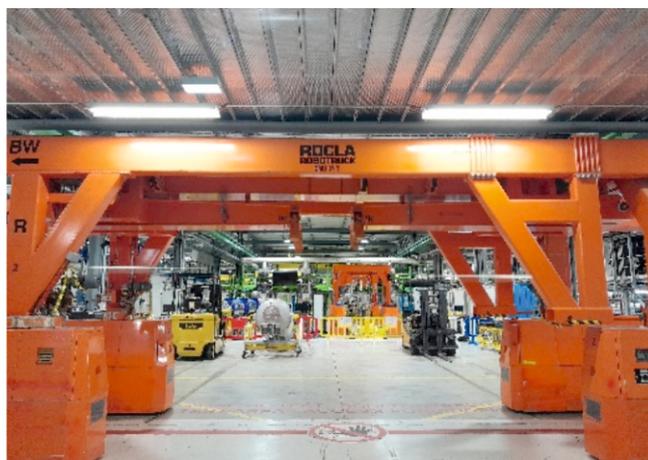
In CMS

A visit to the Magnet Testing Facility and the CERN Control Centre offered an intimate look at superconducting magnet technology. Watching engineers monitor cryogenic systems operating at  $-269^{\circ}\text{C}$  and observing the precision with which magnetic fields steer particle beams provided a vivid demonstration of the Lorentz force in action.

This experience deepened my appreciation for the continuity between school-level electromagnetism and accelerator physics. It also inspired classroom analogues, such as:

- modelling beam steering using simple bar magnets and current-carrying loops,
- demonstrating cyclotron principles with circular coils,
- linking textbook electromagnetism directly to real-world accelerator applications.

These connections help students view physics as a coherent, evolving discipline rather than a collection of isolated topics.



Magnet Testing Facility Centre

Constructing and operating a cloud chamber during the workshop was one of the most impactful hands-on experiences. Using readily available materials—glass, dry ice, isopropyl alcohol, and a black metal plate—I observed alpha and beta particle tracks emerging as luminous streaks in the supersaturated vapour.

This moment was pedagogically significant. It showed that subatomic physics, often perceived as abstract and inaccessible, can be made visible and experiential.

The cloud chamber is thus an ideal, low-cost detector for schools, enabling students to witness cosmic rays and radioactive decay in real time.



Cloud Chamber Workshop

### Bringing ideas and tasks for our classrooms

#### a) Concept Mapping as a Tool for Cognitive Structuring

CERN educators emphasized the use of concept maps to reduce cognitive load and clarify hierarchical relationships among ideas. Participating in these sessions showed how concept mapping helps students build coherent mental models of complex topics.

In my classroom, I now use concept maps for topics such as:

- electric and magnetic fields,
- nuclear reactions,
- motion of charged particles in magnetic fields.

Encouraging students to create their own maps before exams fosters metacognition and strengthens conceptual integration.

#### b) Multilingual and Sign-Language Analogies for Symbolic Literacy

A particularly memorable pedagogical moment occurred during group presentations, when we, the participants, used sign language and multilingual cues to explain concepts such as magnets and engineering. This creative approach highlighted the linguistic nature of physics—its symbols, structures, and representations.

Inspired by this, I now introduce particle symbols ( $\mu$ ,  $\tau$ ,  $\nu$ ) as elements of a new “alphabet,” using gestures and analogies to help students interpret their meaning. This strategy demystifies symbolic notation and boosts student engagement.

#### c) Collaborative Inquiry Through the Study-Group Model

Working in multinational study groups at CERN was intellectually enriching. Each participant brought unique cultural perspectives, analogies, and teaching strategies. This collaborative model has since informed my classroom practice.

Students now work in small research teams to investigate topics such as electricity and magnetism, atoms and molecules, or simple machines. They present their findings using models, analogies, or demonstrations, thereby developing scientific communication skills and collaborative problem-solving abilities.



In front of Einstein House, Bern

### Low-Cost CERN-Inspired Experiments for Schools

#### a) Cloud Chamber Construction

**Cost:** ₹ 1500–₹ 2000

**Concepts:** cosmic rays, radioactive decay, particle tracks

#### b) Drift Chamber Simulation

Using cardboard, coloured straws, and a laser pointer, students simulate charged-particle trajectories and understand how detectors reconstruct tracks.

#### c) Higgs Boson Data Analysis

With publicly available CERN datasets, students can:

- plot invariant mass distributions,
- identify the Higgs “bump,”
- learn basic statistical analysis.

This introduces authentic data-driven inquiry without requiring advanced software.

### **Reflections: The Educational Significance of CERN**

The CERN HST Programme demonstrated that authentic scientific exposure profoundly influences teaching practice. My personal experiences—standing beside monumental detectors, observing superconducting magnets in operation, and witnessing cosmic rays in a cloud chamber—reinforced the idea that modern physics is not beyond the reach of school students. Rather, it requires pedagogical strategies that emphasize visualization, inquiry, and conceptual coherence.

Integrating frontier science into classrooms cultivates curiosity, confidence, and scientific imagination. It empowers students to view physics not as a static collection of formulas but as a dynamic exploration of the universe.

### **10. Conclusion**

The CERN HST Programme is more than a professional development initiative; it is a catalyst for pedagogical transformation. By incorporating concept mapping, low-cost detectors, collaborative inquiry, and real data analysis, teachers can make particle physics both accessible and inspiring. The future of physics education lies in blending the fundamentals of the curriculum with the excitement of modern

research, enabling students to engage with the universe as an evolving interplay of particles, forces, and ideas.

### **Acknowledgements**

I gratefully acknowledge the CERN International High School Teacher Programme coordinators, the scientists and educators who facilitated the sessions, and my fellow participants whose insights enriched the experience. I also thank my students for their enthusiasm during classroom implementations.

### **How to apply:**

*The International High School Teacher (HST) Programme at CERN, Geneva is a prestigious two-week residential professional development workshop that immerses in-service high-school science teachers in particle physics through lectures, on-site visits, hands-on activities and study groups, and is delivered entirely in English to teachers from around the world, with applications typically opening 1st November and closing mid-January each year via the official CERN Teacher Programmes website (<https://teacher-programmes.web.cern.ch/>) where candidates must create a CERN guest account to complete the online form, submit personal and school details, a short CV, answers to motivational questions and a 1-minute self-introduction video, and selections are communicated in the spring, with preference often given to those demonstrating leadership in science education.*

## Olympiad Programmes introduced in India

Vijay Kumar

Coordinator: IAPT-Asian Physics Olympiad  
Principal, Dhanauri P G College, Haridwar, Uttarakhand  
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### 1. Introduction

Olympiad programs in India help assess a child's problem-solving ability and ensure the attention that a student needs to stand out among the crowd. These competitive examinations are aimed at assessing conceptual understanding, reasoning, analytical thinking and problem-solving ability of students beyond the scope of school education. Olympiad movement in India picked up on a large scale after the 1980s following systematic training of athletes and Olympians and other stakeholders. The Homi Bhabha Centre for Science Education (HBCSE), a unit of Tata Institute of Fundamental Research, Government of India is the nodal agency for Olympiad conducted in subjects like Mathematics, Physics, Chemistry, Biology, Astronomy and Junior Science. India screens a talent pool of students through a multi-staged selection process, based on criteria including performance in National-Standard Examinations (NSE). National Standard Examination is organised by the Indian Association of Physics teachers (IAPT). Apart from the government funded Olympiads including a number of National and International level non-profit private organizations, conduct their Olympiad examinations to promote early scholastic activity & developing competitive spirit among school children. Through these programs, we seek to enhance school learning by nurturing curiosity, creativity and higher level of thinking. On the whole, Indian Olympiad programmes contribute in

a big way to promoting a strong scientific temper, global competitiveness and culture of excellence amongst the youngsters; thus, propelling our Nation towards lofty aspirations in Education, Research and Innovation.

### 2. Global Relevance of Olympiad Programmes conducted by India

It has its own importance at the international level and

standardize the issue of India as far as academics, intellectual nurturing, science & mathematics education are concerned. By regularly and successfully participating in the International Olympiads (IMO, IPhO, IChO, IBO and APhO), India has made its presence felt in the global academic community. Such programmes are means to select and nurture top students by advanced curricular according to global norms. Indian Olympiad delegates often win medals and honourable mentions and thus add to the country's stature in academics and help build the soft power of India in education and research. The rigorous selection from these institutions like HBCSE-TIFR and the mentoring process is in place, which makes students well prepared to compete with the best brains across the globe. More broadly, India's Olympiad efforts foster international collaboration and cultural interaction. Students communicate with peers and mentors in many different countries leading to enhanced intercultural understanding, worldwide scientific collaboration and exposure to other ways of tackling problems. Several (APhO, IMO, IPhO, IChO, IBO) alumni from India have been studying at top class global Universities and conducting research, thereby contributing to science, technology and innovation across the world. India's performance in the Olympiad programs is also an inspiration for us to reform education and enrich our curriculum with innovative teaching learning resources to promote inquiry based learning and critical thinking, which are essential to face challenges of today's world in science. Therefore, the global significance of India's Olympiad programs transcends mere medal tallies and rankings. It is about the creation of future scientists, promoting international academic connections, and being a force multiplier in the global knowledge economy.

### 3. Reasons for Poor Uptake of Olympiad Programs in India

The academic potential of Indian students is huge, the participants revealed to us; however, Olympiad participation in India still lags behind national school student heads count. This is for several reasons:

- **Lack of Awareness:** Many students and their parents, sometimes even teachers are unaware about the Olympiad programs of the Country. The unawareness is mostly seen in rural and semi urban areas, about Olympiad examinations/Olympiad programs.
- **Curriculum Oriented Education System:** The Indian school education system is primarily an examination centred method of learning, revolving around board exams, entrance tests and syllabus coverage. The Olympiads demand advanced, beyond the-textbook thinking and problem-solving skills that puts students.
- **Limited Teacher Training and Guidance:** A deficiency of competent mentors and instructors having Olympiad-level skills limits their students' preparation. In many schools there are not teachers who can teach to students for more advanced thinking and non-routine problem solving.
- **Socio-Economic Constraints:** In many cases, participation includes the cost of registration fees, study materials, coaching expenses and sometimes even travel till final rounds, and these can be expensive for students from underprivileged backgrounds.
- **Urban–Rural and School Infrastructure Gap:** Students in urban areas have access to more facilities such as coaching centres, e-library and peer groups whereas students in rural areas cannot afford these because of poor connectivity, lack of libraries and academic support.
- **Academic Pressures and Time Restrictions:** Students are already overloaded with a high volume of their academic studies, tuition classes and competitive examinations preparation (e.g. JEE, NEET). Olympiad training is viewed as an extra work imposed on the children instead of a part of learning process. Olympiads are not only competitive but also have selection ratio very less. Many gifted children are reluctant to compete because they fear failure, lack confidence or parent

and teacher encouragement.

- **Misconceptions About Olympiads:** There's this prevailing belief that the Olympiads are only for “genius” students, and so many learners who are really just average but super keen to learn don't even try.
- **Language and Conceptual Barriers:** Olympiad problems tend to be filled with high-level terminology and conceptual depth, which can leave students (especially those from English medium seconds language or lower-resourced schools) behind.
- **Insufficient Institutional Incentives:** Olympiads do not carry admissions or immediate prizes like other popular entrance examinations, which demotivates students and institutes. There are various sociopolitical reasons due to which the Olympiad culture in India is not booming; however, talent is not one of them. By tackling them with teacher training, campaigns to raise awareness of the situation among girls' parents and the local community, curricula that are adapted to girls' needs and abilities and financial support for studies, India has a lot of room for growth in this area, a change from which India would clearly benefit.

#### 4. Steps to Popularize Olympiad Programs in India

A multifaceted, integrated approach between schools (students-teachers-principal), parents, teachers and the government would be needed to increase participation in Olympiads in India. The following actions can aid in awareness, access and student participation:

- **Nationwide Awareness Campaigns:** Organize structured awareness drives including through schools, education boards and digital media for students, parents and teachers about Olympiads, its advantages and where it adds to your career lifecycle. The Asian Physics Olympiad (APhO) cell organises the workshop “Performance based Olympiad Level Experiments (POLLEX) in all areas of the country.
- **Integration with School Curriculum:** Integrate Olympiads based problem solving logical reasoning conceptual questions with regular class room teaching. This decreases the fear and lets students view Olympiads as an extension of their study rather than something extra.

- **Teacher Training and Capacity Building:** Conduct trainers work-shop, certification programmes and refresher courses for teachers in Olympiad level concepts and pedagogy. Highly qualified teachers are key motivators and mentors for student engagement.
- **Primary and Middle School Level Early Exposure:** Bring Olympiad style age-appropriate activities; early exposure helps create a curiosity in analytic thinking and builds a foundation of confidence.
- **Financial Support and Scholarships:** Give fee waiver, travel grants & free study material and scholarship to the Economically weaker students. Government and CSR funded projects are also very important as they have a potential to allow inclusiveness.
- **Strengthening Rural and Government Schools:** Develop Olympiad resource centres, mobile training units and an e-mentor program to address the urban–rural divide as well as remote under-resourced schools.
- **Digital Tools and Free Resources:** Encourage good quality free or low-cost online lectures, problem sets, mock tests and guidance in multiple languages Indian to cater a broader student base.
- **Parental and Community Engagement:** Prepare and orient parents about the long-term academic and cognitive benefits of Olympiads, to minimize resistance on account of exam pressure or false beliefs.
- **Recognition and Incentives:** The schools/Colleges should offer certificates, prizes, school-based recognition, academic credit and/or preference in college admission or scholarships to encourage students and institutions.
- **Cooperation with national Boards and Universities:** Urge CBSE, ICSE, State Boards and other Educational Institutions to Accept Olympiad Performances, as appropriate reference in their student's mark sheets or any other acceptable certificate, under their official seal and signature.
- **Mentorship by Olympiad Alumni:** Involve former Olympiad participants and winners with the students by guiding them, giving speeches and sharing their

experiences to increase the credibility of Olympiads.

- **Policy-Level Support:** Frame guidelines for Olympiad participation as part of the talent identification and enrichment programme within broad policies at the national/state levels under NEP.

## 5. Conclusion

The study indicates that Olympiads in India have the potential to lead (a) academic excellence, (b) scientific temper and higher order thinking skills among students but participation is grossly proportionate with a country like ours having huge number of students. It is quite evident from the above analysis that are not players missing out on quality, but it's caused by issue systemic like lack of knowledge or proper awareness, rigidity of curriculum system in a large part, insufficient training for coaches and teachers not coming through socio-economic problems and fair access to resources across the nation. The results also underscore that a broad and inclusive approach is needed if greater participation in Olympiads store programs is to be realized. Strategic interventions such as promotion and advocacy campaigns, early exposure, inclusion in curriculum content, teacher development needs to be augmented by financial support and current applications of digital platforms. Equally critical is policy support, institutional recognition and role modelling by Olympiad alumni for sustaining a culture of academic competition and confidence in the long term. Finally, developing Olympiad participation in India is not only about increasing medals won at international contests. it is about the creation of a vibrant ecosystem that encourage gifted young students from all walks of life. Through the synergistic adoption of proposed initiatives, India can productively utilize its human capital, create more equitable access to power and knowledge, and increase its competitiveness in science, engineering and innovation. To increase Olympiad participation in India, there is a need for systemic change, increasing awareness, access and mentorship eco-system. Given the large student body and intellectual diversity that India has, such measures can help discover surreptitious talent, promote scientific temper and boost our global academic standing.

## Celebration of National Mathematics Day-2025

On the occasion of celebration of “National Mathematics Day 2025”, IAPT RC 08 and Marathi Science Council, Dhule Division jointly organized “One Day Workshop for Mathematics Teachers” on Dec 22, 2025. This day marks the birth anniversary of the great mathematician, Ramanujan, who delved into the mysteries of infinity. With the aim of reducing the fear of mathematics among students, increasing their interest in the subject and addressing the mental challenges associated with teaching mathematics, this workshop was organized. The teachers were from various secondary higher secondary schools in Dhule city and nearby rural areas. The venue of the workshop was at J. R. City High School and Junior College, Dhule. The Education Officer (Secondary) Z. P. Dhule, granted permission to teachers for participation in the workshop. A total of 40 mathematics teachers attended the workshop.



The workshop was inaugurated at 9.30 am by Hon. Prin. Dr. K. B. Patil (Mathematician, Former VC, KBC NMU Jalgaon). Hon. Mr Kishor Patil (President, MSC Dhule Division) and Hon. Mr R. K. Pathak (Prin. J. R. City High School and Junior College, Dhule) were present as the chief guests.

In the workshop, expert guide V. Y. Dabke (Retired HM & Treasurer, MSC, Dhule Division) spoke on "Some Mathematical Formulas Useful for School Students," Mr N. M.

Joshi (Secretary, Ghaskadbi Education Institute, Dhule) spoke on "Learning Mathematics Through Activities," Dr. R. M. Shewale (EC Member, IAPT RC 08) spoke on "Olympiad Examinations at school and College Level," and Dr. Nandkishor Bagul, K.S.K. New City High School, Dhule, provided practical guidance on the topic of "Measures to cultivate an interest in mathematics among students". Few speakers used audio-visual aids in their presentations.



Valuable assistance and guidance for this workshop was received from Marathi Science Council Dhule Division office bearers, and recipients of the Marathi Science Council PG scholarship. The management of J. R. City High School and Junior College, Dhule, Principal Mr R. K. Pathak, teachers, non-teaching staff, and the principals/headmasters of the schools of the participating mathematics teacher representatives also provided valuable cooperation.

**R M Shewale**  
Coordinator

**Nandini Raha Memorial Workshop on Physics Experiments – 2025**  
**(Venue: The Bhawanipur Education Society College, Kolkata)**

In the fond memory of the quintessential Prof. Nandini Raha, the “**NANDINI RAHA MEMORIAL WORKSHOP ON PHYSICS EXPERIMENTS – 2025**” was jointly organized by the **Department of Physics, The Bhawanipur Education Society College, Kolkata**, and **RC-15**. The three-day workshop was held from **10th December 2025 to 12th December 2025**, from **10:00 a.m. to 4:30 p.m**

Thirty students from various colleges of Kolkata were selected to participate in the workshop.

In the **Inaugural Session**, **Dr. Anindita Ray**, Joint Convener, The BES College, warmly welcomed the participants and distinguished members of RC-15. This was followed by an encouraging address from **Prof. Dilip Shah**, rector and Dean of students affairs, motivated the students for this valuable opportunity in the field of experimental physics, through this workshop.

Subsequently, **Dr. Pinki Saha Sardar**, Vice-Principal (Science), The BES College, encouraged the enthusiastic students for their participation. The session concluded with a few heartfelt words by **Dr. Bhupati Chakrabarti**, a senior Member of IAPT and Former Associate Professor, City College, Kolkata, who spoke about the immortal legacy of Prof. Nandini Raha. He highlighted her life as a shining example of simplicity, discipline, and deep dedication towards physics which obviously deserves a profound admiration and reverence. He also added that this workshop stands as a lasting tribute, carries forward Prof. Nandini Raha's legacy beyond all limits and boundaries, and serves as a cherished memory to be recalled. Thereafter, following a Hi-Tea break, the Technical Hands-on Session was started. The expert resource persons, **Dr. Surajit Chakrabarti and Dr. Bhupati Chakrabarti** set up 13 experiments using simple, low-cost materials and everyday items such as G I wire, flask, ruler, cylinders, lenses and other easily available objects like smartphones etc. These in-expensive materials were beautifully arranged to

demonstrate and realize the empirical laws of physics at the tabletop level.

Initially, 30 students were paired to form fifteen groups. Subsequently, IAPT members—namely Prof. Manimala Das, Dr. Lipika Satra, Dr. Shinjini Dasgupta, and Dr. Jonaki Chowdhury assigned experiments to the student groups for the first half of the session. Our respected resource persons, Dr. Surajit Chakrabarti and Dr. Bhupati Chakrabarti, interacted with the students and assisted tirelessly at every stage of the experiments. All IAPT members, namely Dr. Swati Das, Dr. Mita Chowdhury, Smt. Sukla Chakraborty and others also guided the students to ensure a better understanding of the assigned experiments. The dedicated efforts of the budding students transformed the experimental challenges into successful ventures, achieving qualitative outcomes within a limited time frame. Surprisingly, a group of students from the previous year were also present to immerse themselves again in the unique experience of experimental physics.

We gratefully acknowledge that BES provided all necessary facilities, ranging from well-equipped laboratory set-ups to computer resources. In addition, a hot and delicious lunch was served to all the participants each and every day.

After the lunch session, new sets of experiments were assigned to the groups who had completed their earlier tasks. The first day concluded with brownies and tea, accompanied by the sparkling enthusiasm in the eyes of the students.

On the next day (11.12.2025) the students performed more experiments, in turn, till 5.30 pm.

On the third day (12.12.2025), the students assembled well in advance, as many of them were eager to perform a maximum number of experiments. The post-lunch session was scheduled for the Valedictory Session and Certificate Distribution. Unlike the usual laboratory sessions (from personal experience), the

students were highly enthusiastic and thrilled, and they successfully performed at least 8 to 9 experiments within a very short span of time.

Dr. Suparna Basak of BES College hosted the Valedictory session and shared her rare experiences and privilege of working with Prof. Nandini Raha. Thereafter, Dr. Samir Kanti Dutta of the BES College expressed his deep gratitude to IAPT RC-15 for

organizing such a meaningful initiative and event for the budding minds of the nation. Prof. Manimala Das of RC-15 paid tribute to her revered mentor, Prof. Raha, and encouraged students to aspire to follow in her footsteps. After the distribution of certificates, the participants expressed their hearts to join similar laboratory workshops in the future that go beyond conventional boundaries and academic syllabi.



**Swati Dass  
Shukla Chakraborti**

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**Report (Him Anveshika)**

### **Physics Workshop in Dharamshala**

A bucket filled with water and suspended from a high roof sparked the opening atmosphere during the workshop on 'Joy of Physics' held in Govt. Senior Secondary School Passu in District Kangra in Himachal Pradesh on 10th February 2026. The concepts of oscillation, time period, frequency, wave number were developed slowly during this engaging session by Him IAPT Anveshika coordinator Dinesh Kumar Sharma.

The demonstrations on transverse waves and longitudinal waves using diverse demos were performed by the students themselves and various innovations were tried with these demos. The two-hour long session unfolded the concepts of centre of mass, how the mass distributions stabilizes the structures, the science of stability, principle of moments and fun games which were actively

participated by the students. The beauty of the session was that it was not one sided communication rather 140 students had always some meaningful interactions throughout the interactions. The observation based definitions were crafted by involving the students by weaving the observations with the known facts and all this went beyond the text books. When the session on feel of one newton force was in process, and the students were asked to apply a force of one newton on a spring balance, 75% of the students randomly selected for this task applied the exact force.

Principal Ms. Nidhi Sharma and the coordinator, Ms. Pooja Awasthi, the Physics lecturer, helped the students in giving their best during the workshop. The workshop was actively attended throughout by all the teachers. This was a perfect joy of physics indeed.



**Dinesh Kumar Sharma**  
Co-ordinator

### Report (RC-07)

## Second Regional Annual Convention

The Second Regional Annual Convention of the RC-07, in conjunction with State Level Final of CPEX (Competition for Physics Experiments) 2026, was successfully conducted on January 27, 2026, at P. D. Patel Institute of Applied Sciences, CHARUSAT, Changa, under the theme “Emerging Quantum Technologies.” The event witnessed the active participation of 90 attendees, including school students, B.Sc. and M.Sc. students, research scholars, and teachers from various institutions across the state of Gujarat.

In the inaugural session, Prof. C. K. Sumesh, Convener of the program, welcomed all distinguished guests and participants. Prof. P. C. Vinodkumar, President of RC-07, elaborated on the theme “Emerging Quantum Technologies” and emphasized the growing importance of quantum science and technology in modern research and industry. Prin. Pruthul Desai, Secretary of RC-07, presented the various activities undertaken by IAPT to strengthen physics education. The inauguration was further enriched by the inspiring remarks of Prof. A. R. Jani and Prof. K. N. Joshipura.

The technical sessions featured expert lectures that provided deep insights into emerging quantum technologies. Dr. Deepak Mishra, Scientist at SAC-ISRO, delivered an informative talk on quantum

communication, satellite communication, Quantum Key Distribution (QKD), and related advancements, highlighting India's progress in secure satellite-based communication systems. Prof. V. N. Potbhare, Retd. Prof., MSU, Vadodara, presented a comprehensive talk on the fundamentals of quantum mechanics and emerging quantum technologies, helping participants connect core quantum principles with day-to-day applications.

A major highlight of the convention was the post-lunch CPEX-2026 innovative experiments exhibition and evaluation session, where students presented physics experiments demonstrating conceptual understanding, creativity, and practical skills. CPEX promotes experiential learning beyond traditional classroom methods and encouraged innovation and research orientation among students. During the convention, Cluster Coordinators presented their annual reports and discussed future academic activities fostering regional collaboration and strengthening academic networking under RC-07. It was decided that the best Cluster will be selected, based on their activities during the year, and will be provided with some incentive in the form of more funds to that cluster in the next academic year. I feel elated to announce that the South Gujarat Cluster (i.e. Cluster 2) was declared the best cluster by the panel of

judges consisting of Prof. Minaxi Vinodkumar, and Prof. Rekha Patel.

The valedictory session, coordinated by Prof. Viresh Thakkar, marked the culmination of the event, during which the winners of CPEX-2026 were declared and felicitated with certificates and gifts. Students who achieved recognition at state and national levels, in various competitions/events organized by IAPT

throughout the year, were also honoured. Overall, the Second Regional Annual Convention successfully created a stimulating academic environment that promoted scientific thinking, analytical skills, collaborative learning, and research interest among participants. The event significantly contributed to enhancing the quality of physics education and advancing awareness of emerging quantum technologies in the region.



Viresh Thakkar

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## Report (RC-08C)

### Workshop on Making of LED Bulbs

#### 1. Introduction

The Department of Physics, S. P. College, Pune, in collaboration with SRC-08C (Pune), organized a hands-on workshop on “Making of LED Bulbs: Chargeable and Non-Chargeable” on 17<sup>th</sup> December 2025. The workshop aimed to provide students with practical knowledge and skills in constructing LED bulbs, thereby bridging theoretical physics concepts with real-world applications.

#### 2. Sessions

The workshop was inaugurated in the presence of Head, Department of Physics Dr. Nilesh Waghlikar and President SRC 08C, Mrs. Manisha Hawaldar, who emphasized the importance of skill-based learning and innovation in physics education.

##### First Session: Lecture by Dr. Avinash Rokade

- Topic: “Basic Information of AC/DC LED

Chargeable and Non-Chargeable Bulbs: Different Components and Their Functions”

- Dr. Rokade explained the physics behind LED bulbs, their working principles, and the role of different components.
- Students gained a clear understanding of the scientific foundation of LED technology.

##### Second Session: Demonstration

- Dr. Rokade and his team demonstrated the mounting of components for both chargeable and non-chargeable LED bulbs.
- This session provided practical exposure to the assembly process.

##### Third & Fourth Sessions: Hands-on Construction

- Around 100 students actively participated.
- Each student constructed their own LED bulb under guidance.

- Completed bulbs were distributed among the participants, giving them a sense of achievement and ownership.

### 3. Outcome

- Students acquired practical skills in assembling and constructing LED bulbs.
- The workshop successfully combined theoretical knowledge with hands-on practice.
- The objective of enhancing students' skills in LED bulb making was fully achieved.



### 4. Conclusion

The workshop on “Making of LED Bulbs: Chargeable and Non-Chargeable” proved to be highly beneficial for students. It not only deepened their understanding of the physics behind LED technology but also empowered them with practical skills. The enthusiastic participation of 100 students highlighted the success of the event, making it a memorable and impactful learning experience.



**Shashikant Shinde**  
Secretary

### Report (RC-08F)

## One-Day International Webinar on **The Quantum Enigma: Unveiling Reality Secrets**

**Date:** 24<sup>th</sup> January 2026 **Time :** 2.00 PM to 7.00 PM **Mode:** Online **Platform :** Google Meet

The One-Day International Webinar was organised by Mahatma Basweshwar Mahavidyalaya, Latur, in collaboration with the SRC-08F, Marathwada Region, Maharashtra.

The programme commenced with a warm and cordial welcome extended by Prof. R. Devhade of the Electronics Department, MBML, who served as the anchor for the session. In his opening remarks, he eloquently outlined the theme, objectives, and significance of the webinar, setting a reflective and inquisitive tone for the day.

The webinar was formally inaugurated with an insightful Presidential Address by Hon. Shri Madhavrao Patil (Taklikar), Secretary, MBES, Latur. In his address, he emphasised the transformative

potential of quantum science in driving future research and innovation. He eloquently underscored the importance of understanding the enigmatic nature of reality as we advance further into the realms of quantum technology, inspiring all participants to view science as a bridge to the future.

The inaugural session was graced by the presence of the Chief Guest, Dr. K.M. Jadhav, he shared insights into the emerging domains of quantum technologies and emphasised their growing significance in shaping contemporary scientific research.

The august gathering was then introduced to the International Speaker, Dr. Zaklina Lubej of Mahle Constructor University, Slovenia, through a gracious and well-articulated introduction by

**Dr. S. M. Dongarge.** Dr. Lubej delivered a highly engaging and thought-provoking presentation on the intriguing relationship between quantum science and neuroscience. She eloquently explained how the intricate patterns of the human brain reflect the natural diversity of human intellect rather than anomalies or illness. Her scholarly discourse effectively bridged quantum principles with neurological systems, offering students and faculty a rare interdisciplinary perspective that proved to be both enlightening and inspiring.

Subsequently, the assembly was formally introduced to another distinguished International Speaker, Dr. Antonija Barisic of Velika Gorica, Zagreb, Croatia. He delivered an insightful and academically enriching lecture, wherein she elaborated on the practical and transformative applications of quantum physics in the present-day scenario. Her scholarly deliberations proved highly beneficial for faculty members, researchers, and students alike, as she emphasised the growing importance of quantum advancements in shaping the future of global scientific and technological development.

The Keynote Speaker, Dr. G. H. Jadhav, Principal of Chatrapati Shivaji Mahavidyalaya, Umerga, elaborated on the fundamental principles of quantum physics and explored their profound philosophical implications. His lecture not only clarified intricate concepts but also stimulated meaningful reflection and discussion among the participants on the nature of

reality, the principle of uncertainty, and the continuing quest for a unified theory in physics.

After the keynote address, the programme moved to a dynamic Question and Answer session, which witnessed active and enthusiastic participation from delegates across the country and abroad. Several pertinent and thought-provoking questions were raised by the participants on various aspects of quantum phenomena, philosophical interpretations of modern physics, and the societal implications of emerging quantum technologies. Queries were ably and patiently addressed by the eminent resource persons — Dr. G. H. Jadhav, Dr. K. M. Jadhav, Ms. Zaklina Lubej, and Ms. Antonija Barisic. The vote of Thanks was proposed by Prof. K.V. More from the Department of Commerce.

The programme then drew to a close with the valedictory remarks delivered by Prof. Ram Devhade Sir. He underscored the importance of nurturing curiosity, diligence, and a spirit of intellectual rigour among students, teachers, and researchers.

In conclusion, the webinar not only strengthened scientific temperament and philosophical understanding among teachers, students, and researchers but also served as a remarkable platform for knowledge sharing, global collaboration, and inspiration. The programme will undoubtedly have a lasting impact on all participants, motivating them to advance in their academic pursuits with dedication, curiosity, and intellectual rigour.



Inaugural speech: Dr. K. M. Jadhav



Ms. Zaklina Lubej

**A.H. Hedaoo**  
Asstt Professor , CS Dept.

## Lecture Series

The Sub-Regional Council Vidarbha, organized a lecture series during the recent visit of Prof. P. C. Deshmukh to Nagpur. The visit evolved into a vibrant academic celebration of physics, featuring three lectures delivered at three different venues on diverse and intellectually stimulating themes.

Prof. Deshmukh, an eminent theoretical atomic physicist and former Vice President of IAPT, engaged audiences comprising postgraduate students, research scholars, and senior faculty members. The lectures were hosted at leading academic institutions in Nagpur, (i) VNIT, (ii) Postgraduate Teaching Department of Physics, RTM Nagpur University, and (iii) GHRCE. Each session witnessed enthusiastic participation and lively interactions.

His talks spanned frontier areas of contemporary physics, ranging from attosecond science and ultrafast electron dynamics to the significant contributions of Bharatiya physicists to global scientific progress. With conceptual clarity and historical insight, he highlighted how foundational ideas in quantum mechanics, atomic physics, astrophysics, and modern theoretical frameworks evolved and how Indian scientists have played a defining role in shaping them.

The series also fostered meaningful dialogue among senior physics educators of the region, strengthening academic networking under the IAPT banner. Prof. Deshmukh's lucid exposition, depth of scholarship, and inspiring reflections left a lasting impression on the audience.

Shyamkant W. Anwane

## Report (Taxxila Anveshika)

### Activities from School to the College students

After the Anveshika coordinators meet (MAC – 25) in June 2025 at DBS Global University, Dehradun, Taxxila – Anveshika performed hands-on activities in different institutes of West Bengal to establish that Physics can be made very interesting and simple by including a few hands-on experiments in the class-room lectures.

**Activity 1:** 1<sup>st</sup> July, 2025, Nityananda Boi Bari, Lakshminathpur, Domkal, Murshidabad. Exclusively for little school children.

**Activity 2:** 1<sup>st</sup> Sept., 2025 Bhawanipur Education Society College. For the students of different schools (Class X).

**Activity 3:** 19<sup>th</sup> Oct., 2025, Dishari Physics Academy, North 24-Parganas. For the students of classes X, XI, XII.

**Activity 4:** 7<sup>th</sup> Nov., 2025, Barasat Govt. College. North 24-Parganas, On the occasion of 75-th year anniversary of the college. In

collaboration with Anuranan.

**Activity 5:** 5-th Jan., 2026, Vidyasagar Vidyapith Girls' HS School, Midnapore. Inauguration of Anveshika Physics Bharat Yatra.



Amit Kumar Jana

## Lecture on 'History of Indian Astronomy'

### 1. Introduction

The Department of Physics at Bharat English Medium School and Junior College organized an enlightening lecture in association with SRC 08C (Pune) on “History of Indian Astronomy” delivered by Dr. Shobha B. S. The session was attended by high school and junior college students, aiming to introduce them to the rich heritage and scientific contributions of Indian astronomy. Dr. Shobha B. S. is working under COSMOS project at the Indian Institute of Astrophysics (IIA, Bangalore, India), as a Visiting Scientist.

### 2. Highlights

#### Tradition of Indian Astronomy

- Dr. Shobha emphasized the continuous tradition of observation, computation, and instrumental innovation in Indian astronomy spanning several centuries.
- She explained how astronomical manuscripts reflect the diversity of scripts, languages, and mathematical techniques across different historical periods.

#### Medieval Texts and Precession

- Special focus was given to medieval astronomical texts and the methods developed for correcting precession of the equinoxes, showcasing the advanced mathematical understanding of Indian scholars.

#### Astronomers and Innovations

- The lecture highlighted contributions of notable Indian astronomers and their innovative approaches to solving astronomical problems.

#### Evolution of Instruments

- Students were introduced to traditional instruments such as the manyantra and sundials, along with their practical applications in daily life.
- The relevance of these instruments in timekeeping and navigation was discussed, connecting ancient practices to modern contexts.

#### Use of Sārinī Tables

- Dr. Shobha explained the innovative use of sārinī (ready-reckoner) tables in almanac making.
- These methods demonstrated how ancient

computational techniques continue to inform contemporary practices.

#### Socio-Cultural Contexts

- Selected examples from inscriptions and manuscripts illustrated the interaction between astronomical theory, mathematical practice, and socio-cultural life in India.

#### Career Guidance

- Towards the end, Dr. Shobha provided a brief introduction to career opportunities in astronomy, encouraging students to explore research and applied fields in this domain.

#### 3. Outcome

- Students gained a deeper appreciation of India's scientific heritage in astronomy.
- The lecture successfully connected historical knowledge with modern relevance, inspiring curiosity among young learners.
- The career guidance segment motivated students to consider astronomy as a potential academic and professional path.

#### 4. Conclusion

The lecture was both informative and inspiring. It not only highlighted the intellectual achievements of Indian astronomers but also demonstrated the enduring relevance of their methods and instruments. The event enriched students' understanding of astronomy as a discipline deeply rooted in India's cultural and scientific traditions, while also opening doors to future opportunities in the field.



**Shashikant Shinde**  
Secretary

## National Colloquium on Quantum Science Education

The Department of Physics, DDGD Vaishnav College organized the National Colloquium on Quantum Science Education in association with IAPT RC-13 (Indian Association of Physics Teachers – Regional Council 13) on 11th February 2026.. The colloquium brought together eminent academicians, researchers, teachers, and students to discuss the evolving landscape of quantum science and its educational significance.

The distinguished resource persons — Prof. S. Lakshmi Bala, Centre for Quantum Information, Communication and Computing (CQuICC), IIT Madras, and Prof. T. S. Natarajan, IIT Madras and Tirupati, President IAPT RC 13 inaugurated the programme.



Prof. TSN in his inaugural address emphasized the growing relevance of quantum science in research, technology, and education, motivating students and faculty to actively engage in this transformative field.

### Plenary Talk

The first technical session was delivered by Prof. S. Lakshmi Bala on the topic “*Quantum Concepts.*” Her lecture laid a strong conceptual foundation for understanding quantum mechanics. She addressed the challenges in learning quantum physics, particularly its abstract nature and reliance on mathematics. Key topics discussed included wave–particle duality, the photoelectric effect, wavefunctions, measurement, uncertainty principle, quantum superposition, qubits, and entanglement. She explained how classical determinism differs from quantum probabilistic behavior and highlighted the importance of careful pedagogy when introducing quantum concepts at school and undergraduate levels. Her session effectively bridged fundamental theory with modern

applications such as quantum computing and quantum communication, making the subject accessible and intellectually engaging.



### Panel Discussion

A thought-provoking panel discussion followed, focusing on Teaching Quantum Science Education - challenges and way forward. The discussion revolved around the challenges students face in understanding quantum mechanics, particularly fear of complex mathematics and abstract concepts. The panel included Prof. Ravishankar Chatta Subramaniam, PhD in Physics Education, Purdue University, Dr Balakrishnan Viswanathan, Theoretical Physics Division, IMSc., Chennai and Dr S Dipthi, VIT, Chennai.

The panel emphasized the importance of:

- Introducing quantum ideas at the school level in a simplified manner
- Strengthening foundational skills in algebra and linear algebra
- Using simulations, gamified tools, and interactive platforms
- Encouraging open dialogue between teachers and students to overcome fear

It was highlighted that quantum science is no longer confined to physics alone, but is increasingly relevant across disciplines due to technological advancements and the National Quantum Mission. The discussion concluded with the message that quantum physics is not merely a subject but a new way of thinking.

### Quantum Poster Display

A special highlight of the event was the Quantum Poster Exhibition, created by Prof. P. K. Ahluwalia and members of IAPT. The posters visually represented key quantum concepts in an engaging and simplified

format. During the lunch break, participants actively engaged with the poster display, discussing ideas and clarifying concepts in an informal academic environment. This interactive session fostered curiosity and meaningful exchange beyond the formal lectures.

The concluding session was delivered by Dr. Arijit Sharma, Department of Physics, IIT Tirupati, on “*Sundials to Modern Atomic Clocks – A Brief History.*”

His talk traced the fascinating evolution of timekeeping from ancient sundials to modern optical atomic clocks. He explained the significance of ultra-precise time measurement in satellite navigation, telecommunications, banking, smart grids, deep-space missions, and fundamental research. Dr. Sharma also discussed how atomic clocks contribute to searches for new physics

beyond the standard model and highlighted ongoing initiatives in developing portable optical atomic clocks. The session beautifully connected historical development, modern technology, and frontier physics research.

The National Colloquium on Quantum Science Education concluded successfully with enthusiastic participation of around 80 faculty and PG students. The event provided deep insights into foundational quantum concepts, pedagogical approaches, technological applications, and future research directions. The collaborative effort with IAPT RC-13 made the event intellectually enriching and memorable.

**V. Renganayaki**  
Co-Convener, NCQSE

**Report (RC-12A)**

## **QuantaSouth 2025: Zonal Confluence on Quantum Science, Technology, Student Research & Pedagogy**

**QuantaSouth 2025**, held on January 30–31, 2026, at the RV College of Engineering (RVCE) in Bengaluru, served as a premier regional platform for the advancement of quantum science and education. Organized by the **Indian Association of Physics Teachers (IAPT) RC12A** and **RVCE**, in collaboration with the regional councils of IAPT:

- RC11 Andhra Pradesh
- RC12 Karnataka and Lakshwadeep
- RC13 Tamil Nadu and Puducherry,
- RC14 Kerala
- RC22 Telangana

the confluence celebrated the **International Year of Quantum Science and Technology (IYQST)**. The event successfully bridged the gap between fundamental research and engineering application, emphasizing the transition from the "First Quantum Revolution" (semiconductors, lasers) to a "Second Quantum Revolution" centered on entanglement, quantum computing, and sensing. Critical insights emerged regarding the urgent global shift toward quantum-resistant digital security and the necessity of reforming physics pedagogy to include conceptual quantum themes at the school level. The convention featured 17 oral presentations, 12 poster sessions, and various project demonstrations, highlighting innovations in quantum-nano synergy, cryogenic ion trapping, and five-dimensional cosmological theory.

### **Core Themes and Strategic Insights**

#### **1. The Second Quantum Revolution and Technological Security**

A central theme of the confluence was the ongoing transition

into the "Second Quantum Revolution." Unlike the first revolution, which leveraged low-hanging fruits like lasers, this new era focuses on engineering complex quantum phenomena for large-scale utility.

- **Security as a Primary Driver:** Prof. Shankar Kumar Selvaraja noted that current hype and funding are largely driven by "FOMO" (Fear Of Missing Out) regarding digital security. The potential for quantum computers to crack classical RSA and ECC cryptographic schemes has made the development of quantum-resistant frameworks a matter of national survival.
- **The Theory-Reality Gap:** There remains a significant gap between the "ideal world" of quantum theory and the challenges of experimental realization. Bridging this requires understanding noise, decoherence, and environmental factors that disrupt the "quantum dream."
- **Engineering vs. Physics:** The confluence underscored a symbiotic relationship: Physics provides the "why" and conceptual understanding, while Engineering focuses on "what next"—building and utilizing those concepts for the general good.

#### **2. Pedagogy and Educational Reform**

A significant portion of the event was dedicated to **Physics Education Research (PER)** and the integration of quantum concepts into earlier stages of learning.

- **Constructivism in Education:** Presenters advocated for an "activity-based" or "minds-on, hands-on" approach. Examples included using physical models to visualize electronic configurations and using custom-fabricated protractors to teach solid angles.

- **The "Blended" Teaching Method:** Dr. D. Usharani highlighted the need to move from "discrete" to "blended" modes of teaching, connecting concepts like resonance across mechanical, electrical, and nuclear systems rather than teaching them in isolation.
- **Quantum Science in Schools:** A dedicated panel concluded that early exposure to quantum ideas is essential for scientific literacy. Key recommendations included:
  - Focusing on **qualitative and conceptual understanding** rather than advanced mathematics.
  - Using **everyday contexts and storytelling** (e.g., coin tosses to explain states/uncertainty).
  - Phased implementation supported by rigorous **teacher training** to move away from rote memorization.

#### Theoretical and Experimental Innovations

- **The Cabinet Theory (PI-05):** Presented by Koundinya Gajulapalli (Class 9), this five-dimensional geometric framework proposes that gravity propagates through an extrinsic time-like dimension. It aims to resolve the initial singularity and vacuum energy cancellation without requiring inflation or exotic matter.
- **Three Polarizer Paradox (PI-04):** A project demonstrating the vector nature of light polarization. It showed that inserting a 45° polarizer between two crossed polarizers (at 90°) allows light to pass, highlighting the "paradoxical" increase in transmitted intensity.
- **Quantum-Nano Synergy:** Several papers (OP-16, OP-17) explored "green-synthesized" nanoparticle platforms (Ag-Ni-Co, Co-Fe) for environmental remediation and precision medicine, utilizing Reactive Oxygen Species (ROS) mediated oxidative cascades.

#### Poster Session Insights

A total of nine posters integrated fundamental physics with emerging technology.

- **Key Topics:** AI-assisted quantum tunneling sensors with drift correction, Arduino-based seismic monitoring for the Kashmir region, and structural coloration in butterfly wings as a model for biomimicry in nanotechnology.
- **Strategic Goal:** The session aimed to bridge the gap between fundamental theory and real-world societal applications.

#### Competitions and Recognition

The **InSpirQ 2025 (Shilpa Nandakumar Inspirational Quantum Project Competition)** evaluated various

student-led initiatives based on innovation and conceptual depth.

- **Best Project:** Awarded to the team from **Dayanand Sagar College of Engineering** (Sanchita Nidugala et al.) for their demonstration of the **Three Polarizer Paradox**, cited for its elegance and the students' profound understanding of physics concepts.
- **Special Citation:** Recommended for **Koundinya Gajulapalli** (Class 9) for his unique theoretical work on the "Cabinet Theory."

#### Notable Participants:

- GSSS Institute (Mysore): Software-based enzyme catalysis simulation (Q-Enzyme).
- Agastya International Foundation: Physical models for visualizing electronic configurations.
- PES University: Development of a low-cost, quantum-inspired optical communication system using classical hardware.

#### Supplemental Sessions

##### Night Sky Watch

Managed by the **Association of Bangalore Amateur Astronomers (ABAA)** and **Young Innovators Pvt. Ltd.**, this session combined pedagogy with observation.

- **Overview:** Mr. Ravindra Aradhya emphasized that astronomy is a "long-term, consistent observational science."
- **Practical Observation:** Participants used telescopes to view the moons of Jupiter, the rings of Saturn, and lunar craters. A CCD camera integration allowed live laptop viewing of high-detail lunar features.

#### Notable Guests' Perspectives

"The first quantum revolution... was what we call low-hanging fruits. The second revolution is towards engineering whatever we understand and put it for a large-scale use." — **Prof. Shankar Kumar Selvaraja**. "QuantaSouth... is bringing together the south zone in the southern Quantum mission... Physics for thinking and Engineers for building." — **Prof. Urbasi Sinha**. Building a quantum computer is not a physicist's solo act; it demands the full orchestra — mechanical engineers, architects, mathematicians, cryogenic specialists — every discipline stepping in, because only together can we shape a machine this fundamentally new, mentioned **Prof Akshay Naik**. Early exposure was viewed not as an academic burden but as a means to cultivate curiosity and conceptual awareness." — **Moderator, Prof Udayanandan K M in Panel discussion on 'Need of Quantum Science in Schools'**

**Sarmistha Sahu**, Secretary RC12A

**Dr Rajesh BM**, Convener,

**Dr Niranjana K M**, Co-convener,

**Dr Meera Gumaste**, Organizing Secretary.



Fig.1 Seismic Sensor Innovation by a First-Year Student of IISER Kashmir

**NCIEP 2026**

**Unleash Your Innovative SPARK !**

**National Competition for Innovative Experiments in Physics  
(NCIEP) 2026**

*Since 2003*

Dear Physics Teachers, Students and Science Educators

**You are invited to conceive and set up**

**AN ORIGINAL AND AN INNOVATIVE EXPERIMENT IN PHYSICS**

INNOVATION RATHER THAN SOPHISTICATION IS THE FOCUS

**COMPETITION IS OPEN FOR FOLLOWING CATEGORIES OF PARTICIPANTS**

**A. Teachers at any level / M.Phil / Ph.D (awarded or pursuing) / Scientists from national laboratories / Science communicators (IAPT membership not mandatory).**

**B. Students pursuing UG / PG courses.**

**C. Students studying in classes 9–12.**

Students in Categories B and C may work under the guidance of a mentor  
The experiment must be original and designed by the participant  
Demonstration-type experiments are also welcome  
Participants must demonstrate their experiments themselves

Looking for  
Originality  
Creativity  
Physics Concept Application  
Learning Value

Entry Should Demonstrate  
Clear Objective  
Methodology  
Results and Analysis  
Impact

**Top three experiments from each category will be awarded the following prizes**

First Prize	Second Prize	Thrd Prize
7000/-	5000/-	4000/-

**TEACHERS**  
Focus on adaptability for classroom Teaching  
Simplicity  
Effectiveness for Conveying Concepts

**CLASS 11-12 STUDENTS**  
Focus on Creativity, Simplicity, and Clear Understanding of the Physics Concept

**UG PG STUDENTS**  
Expect more  
Complex Experiments  
Showcasing Deeper Understanding and Application of Physics Concepts

The first round of the competition will be conducted in Online / Offline mode at the respective IAPT Regional Councils.

**Top ten student entries (Categories B & C) may receive Rs 1000/- each towards setup expenses. Participants must bring their own experimental setup for the final round.**

Selected entries from each category will be invited for final demonstration at the IAPT Annual Convention. Dates and venue will be announced later but likely to be held during October-November. Invited participants will be reimbursed travel expenses as per IAPT rules. In case of joint authorship, only one participant will be eligible for TA.

**DECISION OF THE JUDGES WILL BE FINAL.**

**Last date for submission of entries: 31st August 2026**

For queries, please contact  
**Dr Geetha R S, National Coordinator, NCIEP, Mob: 8088812890**

## New Coordinator of National Anveshika Network of India (NANI)

We are pleased to announce that, in an online meeting held on 19.02.2026 for selecting new coordinator of IAPT National Anveshika Network of India, as per the guidelines approved by Executive Council of IAPT (published in December 2024 issue of IAPT Bulletin) and announcement for inviting applications for new NANI Coordinator (published in the January 2026 issue of IAPT Bulletin), **Mr. Dinesh Kumar, Coordinator of Him – IAPT Anveshika, Dharamshala** has been selected as the New Coordinator. He will assume his role from 1<sup>st</sup> March 2026 for the tenure ending 28<sup>th</sup> February 2031.

We extend our heartiest congratulations to Mr. Dinesh Kumar for this new responsibility of a flagship program of IAPT. We are confident that under his coordination, NANI will flourish further and scale new heights.

Selection Committee also put on record exemplary academic leadership provided by Prof. H. C. Verma to NANI and expressed its deep gratitude to him on behalf of IAPT for steering NANI on an innovative path to reach the unreachable.



**Dinesh Kumar**

Him –IAPT Anveshika, Dharamshala  
dineshquiz@gmail.com

We are confident of continued guidance and blessings of Prof. H. C. Verma for NANI and IAPT.

We wish Mr. Dinesh Kumar a successful and fulfilling tenure ahead.

**Rekha Ghorpade**  
General Secretary

## Call for New Chief Coordinator of Exam [CCE]

**Dear Esteemed IAPT Life Members,**

The Indian Association of Physics Teachers (IAPT) has initiated the process for the selection of new Coordinators as per the guidelines approved by Executive Council of IAPT (published in December 2024 issue of IAPT Bulletin) for its various academic and outreach activities. In this regard, applications are hereby invited from our dedicated, enthusiastic, and committed Life Members for the position of **CHIEF COORDINATOR EXAMS [CCE]**

A duly constituted committee will scrutinize all applications received. If deemed necessary, online interactions with shortlisted candidates

may also be conducted as part of selection process.

We sincerely invite our Life Members to come forward and contribute to IAPT by taking up this important responsibility, bringing with them innovative ideas, fresh perspectives, and constructive improvisations to further strengthen our activities.

Interested members are requested to complete the application form and submit it [**online**] to the **IAPT Secretary, Dr. Sanjay Kr. Sharma** before **25<sup>th</sup> March 2026**.

We look forward to your active participation and continued support in advancing the objectives of IAPT.

**Rekha Ghorpade**  
General Secretary

**Application for the Post of Chief Coordinator Exam [CCE]**

**Name of the Candidate:** .....

- IAPT Life Membership Number: .....
- E Mail: .....
- Mobile no. ....
- Address:  
.....  
.....  
.....

**Name of the Proposer:** .....

- IAPT Life Membership Number: .....
- E Mail: .....
- Mobile No. ....
- Signature .....

**Name of the Seconder:** .....

- IAPT Life Membership Number: .....
- E mail: .....
- Mobile No. ....
- Signature .....

The applicant is requested to **attach a brief write-up along with CV** [ word file may be attached] detailing:

- Experience in organizing or coordinating **Any activities/Examination** and
- Vision and plans for strengthening **Examinations conducted by IAPT.**

**Declaration**

I hereby declare that the information furnished above is true and correct to the best of my knowledge. I am willing to take up the responsibilities of the **Chief Coordinator of Examination** and work towards the objectives of IAPT.

**Signature of the Candidate:** \_\_\_\_\_

**Date:** \_\_\_\_\_

**Place:** \_\_\_\_\_

**Please Email the scanned copy of dully filled form and other relevant documents at:**  
**sksharma777@gmail.com**

## Joy of Physics Open Lab coming up in Dharamshala

Government College Dharamshala in Himachal Pradesh has signed an MoU with the Indian Association of Physics Teachers and the National Anveshika Network of India through Him- IAPT Anveshika to mark its centenary celebrations. A Joy of Physics open lab accessible to the community will be established under this initiative.

The MoU was formally signed by Principal Prof. Rakesh Pathania and IAPT central EC member -cum- Him Anveshika Coordinator Dinesh Kumar, marking the beginning of a dynamic partnership dedicated to strengthening hands-on physics education.

Head of the Department of Physics, Dr. Vikram Srivastava, and Coordinator Dinesh Kumar, shared the vision that the Joy of Physics Open Lab will function as an innovative learning space to make physics learning engaging with special focus on experimentation. Beyond regular working hours, the laboratory will remain open during evenings, and even on holidays as per the requirement. School and college students from across Himachal Pradesh will be able to participate in hands-on sessions, special workshops, and guided experimental activities using low cost and advanced scientific instruments.

The initiative also draws academic strength from experts across the region. Prof. Kuldeep Kumar Sharma, from NIT Hamirpur who is also the President of RC 23 stated that the working and retired physicists will be

incorporated to actively support this project. Emphasis will be placed on low-cost, innovative, and concept-driven experiments to enhance conceptual clarity and nurture scientific temperament among learners.

Institutions will be able to book slots in advance for their students, enabling the organization of structured workshops, live demonstrations, and interactive sessions. This approach ensures that students move beyond textbook learning and engage directly with scientific principles through experimentation.

College faculty members Dr. Sarita Kumari and Dr. Govind Singh from the Department of Physics, along with Rajneesh Dewan from the Department of Chemistry, were present on the occasion.



**Dinesh Kumar Sharma**

## On How We Make Sense of Mathematics in Physics

Investigation of student understanding and reasoning with mathematics in physics is a key thread in PER. In this article, we discuss some of the major works in this regard. The paper below gives an overview of the research landscape in this area and the different theoretical perspectives that were developed to address various facets of the problem.

Schermerhorn, B. P., & Thompson, J. R. (2023). Making context explicit in equation construction and interpretation: Symbolic blending. *Physical Review Physics Education Research*, 19(2), 020149. <https://journals.aps.org/prper/abstract/10.1103/PhysRevPhysEducRes.19.020149>

One area of focus is how students construct and make sense of equations. The framework of *symbolic forms* developed by Bruce Sherin is a major work in this regard. He studied how first year college students were solving conceptual physics problems. It was found that often students relied on a sense of what they wanted to express and attempted to construct equations based on that. Thus in addition to formal concepts or contexts in physics, structural understanding of how equations are constructed or written played a crucial role. For example, in one study, two students based on the general sense that often a quantity gets augmented by another term, constructed the following incorrect kinematics expression for change in velocity due to acceleration:  $v_f = v_0 + \frac{1}{2}at^2$ . The educational implication is to identify and highlight the role of culturally shared intuitive knowledge elements known to students like the *base plus change* notion invoked above by students as they constructed their equation for velocity. Highlighting such features will positively impact students' understanding and attitudes toward how mathematics is applied in physics. Researchers have proposed similar symbolic forms such as the 'transformation' symbolic form in the contexts of an operator acting on a vector and the 'reshaping' symbolic form in the eigenvalue-eigenvector context. Further details on symbolic forms can be found in:

Sherin, B. L. (2001). How students understand physics equations. *Cognition and instruction*, 19(4), 479-541. [https://www.tandfonline.com/doi/pdf/10.1207/S1532690XCI1904\\_3](https://www.tandfonline.com/doi/pdf/10.1207/S1532690XCI1904_3)

Another area of focus is the role played by mathematics in reasoning in physics contexts, in contrast to being a tool primarily for calculations and symbolic manipulations. Multiple models have been proposed to describe how students move back and forth between the physical system and its mathematical representations. An illustrative example is the cycle proposed by Redish and Kuo. The cycle starts with what they call the act of modeling wherein one transitions from the physical system under consideration to a mathematical representation. This is then followed by a processing phase which typically involves mathematical procedures like integration or differentiation. Finally, the result coming out of these procedures in the mathematical domain is interpreted so that it can be connected back to the physical system with which one started. For more details on the model see:

Redish, E. F., & Kuo, E. (2015). Language of physics, language of math: Disciplinary culture and dynamic epistemology. *Science & Education*, 24(5), 561-590.

Another similar model describing students' use of mathematics, pitched at a relatively higher (upper division or masters) level, is the ACER framework involving - Activation of mathematical tools, Construction of mathematical models, Execution of the mathematics, and Reflection on the results:

Wilcox, B. R., Caballero, M. D., Rehn, D. A., & Pollock, S. J. (2013). Analytic framework for students' use of mathematics in upper-division physics *Physical Review Special Topics - Physics Education Research*, 9(2), 020119.

**K K Mashood**  
HBCSE - TIFR, Mumbai

**BULLETIN OF THE INDIAN ASSOCIATION OF PHYSICS TEACHERS**

FOUNDED BY (LATE) DR. D.P. KHANDELWAL

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