

Bulletin of



THE INDIAN ASSOCIATION OF PHYSICS TEACHERS

A MONTHLY JOURNAL OF EDUCATION IN PHYSICS & RELATED AREAS

VOLUME 18

NUMBER 9

SEPTEMBER 2026



Astronauts Chris Williams of NASA and Sophie Adenot of the European Space Agency work together in the Kibo laboratory module's Life Science Glovebox, processing genetic-material samples for the DNA Nano Therapeutics-3 experiment. The investigation is exploring DNA-inspired assembly techniques as a way to manufacture treatments—such as chemotherapy and immunotherapy—that can kill cancer cells and activate the immune system.

Link: <https://www.nasa.gov/image-article/science-in-space/>

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

International Accolade for Indian Physicist

Following a more than forty-year-old convention, Abdus Salam International Centre for Theoretical Physics (ICTP) announced the winners of Dirac Medal for 2026 on August 08, the birthday of Nobel laureate British physicist Paul Adrian Maurice Dirac. Among the four winners of the 2026 medal named after Dirac we have our own Prof. Deepak Dhar an outstanding physicist with pathbreaking contributions in statistical mechanics. Prof Dhar becomes the first Indian physicist working in India to win this highly prestigious Medal. In the process he becomes the first Indian to win two very coveted medals named after Dirac and Boltzmann.

Along with him three more physicists, Bernard Derrida of College de France, Paris, Marc Mezard of Bocconi University, Milan, Italy and Haim Sompolinsky of Hebrew University of Jerusalem, Israel and Harvard University, USA have also won the Dirac Medal for the year 2026. They are all winners and not co-sharers. Professor Deepak Dhar who is now an INSA Distinguished Professor at International Centre for Theoretical Sciences (ICTS-TIFR), Bengaluru earlier had a long stint as a faculty member at TIFR, Mumbai. Then he was at IISER, Pune for some time. He hails from Pratapgarh in UP and had his UG studies at Allahabad University. Then he did his M.Sc. at IIT, Kanpur. He earned his Ph.D. from California Institute of Technology (Caltech). As a Ph.D. student at Caltech, he was a teaching assistant to Richard Feynman.



This annual prize was instituted by the Abdus Salam International Centre for Theoretical Physics (ICTP), Trieste, Italy in 1985 in the memory of Paul Dirac who passed away in 1984. Till now the medal has been won upto four physicists of repute in one single year and

it has gone to not less than two winners in a particular year. The award has been announced in all the last forty-two years including 2020 and 2021, the two years when the world was under the devastating grip of Covid 19.

Like any other award there are some guidelines for the selection of winners that is awarded annually for outstanding contribution in theoretical physics or mathematics. Rules allow to have more than one winner in a single year. Another interesting aspect is that the Dirac medal will not be conferred to any scientist who has already won a Nobel Prize or a Fields medal or a Wolf Prize. ICTP felt the winners of these prizes mentioned here had already decorated and have received top accolades for their contributions. So, they wanted to identify some more theoretical physicists and mathematician who are frontline contributors in their own fields but have not yet received the most well-known Prizes in the fields of physics and mathematics.

With these conditions a group of scientists who every year select the winners from among the nominated ones declare the winners every year on August 08. Since there is no bar for a Dirac medalist to subsequently win the Nobel Prize, eight Dirac Medal (DM) winners have subsequently gone to win the Nobel Prize in Physics. One can find David Gross (DM 1988; NL 2004), Martinus Veltman (DM 1996; NL 1999) Giorgio Parisi (DM 1999; NL 2021) Yuichiro Nambu (DM 1986; NL 2008) John J Hopfield (DM 2001; NL 2024) Franck Wilzeck (DM 1994; NL 2004), Duncan Haldane (DM 1993; NL 2016) James Peebles (DM 2013; NL 2019) in this exclusive list. All these go to show how close a Dirac Medal winner comes to win a Nobel Prize. No doubt this is absolutely a Medal for the outstanding theoretical physicists or frontline mathematicians.

Two US scientists of Indian origin Jogesh Pati and E C G Sudarshan have won Dirac medal in 2000 and in

2010 respectively. But Deepak Dhar is the first Indian scientist working in India have won it in 2026. He is an expert in the field of statistical physics and has produced some very well-known students in last 45 years of his active scientific career that still continues. Prof Dhar is the Fellow of all the three science academies of India.

In 2022 Prof Dhar had won the Boltzmann Medal and became the first Indian physicist to receive this acknowledgement. The prestigious medal is earmarked for the physicists working in the field of statistical physics and is awarded in every three years by the Commission on Statistical Physics (C3) of the International Union of Pure and Applied Physics (IUPAP) during the triennial STATPHYS conference, the most prestigious international conference in the field. The Medal was initiated in 1975 and has somewhat similar conditions for selection as those for the Dirac medal. The Boltzmann medal is also not awarded to the scientists who had already won the Nobel Prize and no medal winner is subsequently considered for a second medal.

First ever winner of Boltzmann medal in 1975 the US physicist Kenneth G Wilson went on to share the 1982 Physics Nobel Prize. 1992 winner of the medal Giorgio Parisi has won the Physics Nobel Prize in 2021. In 2022 along with Prof Dhar, the US physicists John Hopfield won the Boltzmann medal. Hopfield shared the Physics Nobel Prize in 2024 barely two years after he had won the Boltzmann medal. Interestingly Hopfield also won the Dirac medal in 2001 well before his Nobel Prize thus fulfilling the conditions thereof. Since Boltzmann Medal is more subject area specific and is awarded only upto two physicists together and that too in every three years the number of winners of Boltzmann medal is much less compared to the Dirac Medal though it started earlier. There are a small group of physicists who have

won both the medals named after Dirac and Boltzmann. And an even smaller group has won the Nobel Prize along with these two Medals.

Prof. Deepak Dhar was chosen for Boltzmann medal for his contributions in the field of statistical physics, including universal long-time relaxation in disordered magnetic systems, exact solutions in percolation and cluster counting problems and the definition of spectral dimension of fractals.

Like Dirac medal the Boltzmann medal is also based on the nominations. The medal is awarded only upto two scientists in the year of award. That way the number of winners of the Boltzmann are much less. And the call for nominations declare “Nominations for a joint award to two scientists, preferably for related work, are acceptable. Nominations should be sent by a principal nominator; names of other nominators should be included in the nomination letter. A nominator can be the principal nominator for only one nomination for the Boltzmann Award. We encourage nominations of women and members of other under-represented groups for the Boltzmann Award”.

After the announcement of the Dirac medal in August 2026 Prof Dhar told *The Indian Express*; “We researchers do not work for medals or recognitions. But the fact that my work has survived over 25 years since it was done, and still considered relevant, is nice to know.”

The 1951-born physicist who was awarded Shanti Swarup Bhatnagar award in 1991 and Padma Bhushan, India's third highest civilian award in 2023, is academically quite active and is a big source of inspiration for his students and co-workers and to the people who know him. IAPT community join hands to extend its heartfelt congratulations to Prof Dhar for his outstanding achievement.

Bhupati Chakrabarti

Physics News

ATLAS and CMS narrow in on twin Higgs production

Finding one Higgs boson was hard enough, but physicists at the Large Hadron Collider (LHC) are hunting for something even more elusive: pairs of Higgs bosons. The discovery of the Higgs boson in 2012 at the LHC marked the beginning of a new era in particle physics. The main challenge in studies of double-Higgs production is that the process is incredibly rare. The exact production rate has yet to be determined, but based on predictions from the Standard Model, researchers expect that for approximately every 1,500 single Higgs bosons produced in LHC collisions, only one pair of Higgs bosons will be produced. The ATLAS Collaboration sees a 2.6-standard-deviation excess above what would be expected without double-Higgs production. Both collaborations also set limits on the Higgs self-coupling parameter, which determines how strongly the Higgs boson interacts with another Higgs boson. Looking further ahead, the High-Luminosity LHC will increase the number of collisions, allowing the experiments to record around six times more data and bringing them ever closer to observing double-Higgs boson production.

Provided by: CERN, Geneva, Switzerland

Using plutonium to probe the universe: Magneto- ν experiment advances dark matter and neutrino research

Astronomers can't see dark matter directly, but they know it's there: Its gravity shapes galaxies and the large-scale structure of the cosmos. In an effort to uncover the composition of this hidden mass, a team at Lawrence Livermore National Laboratory (LLNL) is pursuing evidence of particles that exist beyond the standard model of physics. In a new experimental campaign called Magnetometry for Neutrino physics (Magneto- ν), scientists at LLNL are searching for the sterile neutrino using nuclear beta decays of plutonium-241. Plutonium-241 provides an ideal source because its beta-decay spectrum aligns with the expected mass range of sterile-neutrino warm dark matter, with an average emitted beta energy of about 5 keV. With future large-scale experiments including additional detectors, pixelated sensor arrays and longer measurement periods, Magneto- ν could search for sterile-neutrino signatures in the plutonium-241 beta spectrum more precisely, testing cosmological models that predict sterile-neutrino dark matter.

Read more at: <https://phys.org/news/2026-08-plutonium-probe-universe-magneto-advances.html>

Original Paper: Physical Review C (2026). DOI: 10.1103/4xt7-mdyv

First observation of optical Magnus effect could sharpen quantum computer control

Table tennis professionals are true masters at redirecting fast-moving projectiles. Putting a targeted spin on a serve can make the little white ball fly straight toward the edge of the table but then, at the last moment, take a sharp curve into the left corner. The physical phenomenon behind this sporting trick is known as the Magnus effect. With a tightly focused laser beam directed at an ion, one would expect the strongest interaction to occur where the laser beam is most intense: at its center. However, tightly focusing the laser also changes the spatial structure of its electromagnetic field. For their experiment, the researchers investigated how strongly the calcium ion interacts with the light from a tightly focused laser at different positions. The experiment also revealed a surprising characteristic of the effect: The magnitude of the shift depends solely on the wavelength of the light, not on how tightly the laser is focused. Now, using the trapped calcium ion, the team has succeeded in observing the effect for the first time and characterizing it more precisely.

Read more at: <https://phys.org/news/2026-08-optical-magnus-effect-sharpen-quantum.html>

Soumya Sarkar
Duke University, US

September: This Month in the History of Physics

Scanning Tunneling Microscope: Seeing Atoms One by One

Conventional microscopes use visible light and operate in the classical domain of physics. They cannot resolve individual. The Scanning Tunneling Microscope (STM) is a revolutionary instrument that can image surfaces at the atomic scale. Unlike ordinary microscopes, STM works on the quantum-mechanical phenomenon of electron tunnelling. In September 1981, Gerd Binnig and Heinrich Rohrer published the first paper describing the STM. Their invention marked the beginning of a new era in nanoscience.

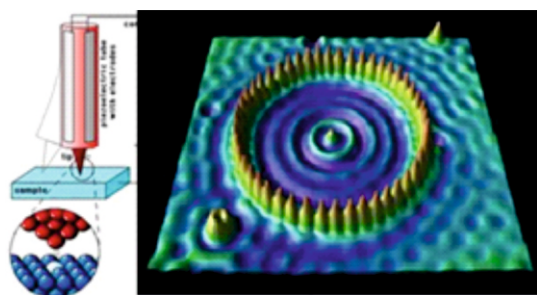


Fig.1: STM and manipulation by STM

An STM has an extremely sharp conducting tip. This tip is brought to within about one nanometre of a conducting surface. At such a tiny distance, electrons can tunnel through the gap between the tip and the surface, even though they cannot cross it in classical physics. This tunnelling produces a very small electric current. As the tip scans across the surface, the instrument keeps the tunnelling current constant by moving the tip slightly up or down. These tiny vertical movements are recorded with extraordinary precision. A computer then uses this information to create a three-dimensional image of the surface. The STM can reveal individual atoms and even the arrangement of atoms on a material. This remarkable achievement earned Binnig and Rohrer the 1986 Nobel Prize in Physics, which they shared with Ernst Ruska, the pioneer of the electron microscope. Their work at IBM's Zurich Research Laboratory opened a new window into the nanoworld. Today, the STM is one of the most important tools in nanoscience and

nanotechnology. It is widely used to study atomic structures, semiconductor surfaces, self-assembled molecular layers, catalytic reactions, and even biological molecules such as DNA. It has transformed our ability to explore and manipulate matter one atom at a time.

The Large Hadron Collider: Exploring Nature's Deepest Secrets

The Large Hadron Collider (LHC) is the world's largest and most powerful particle accelerator. It accelerates protons or heavy ions to speeds very close to the speed of light. The LHC began operation on 10 September 2008 at CERN, the European Organization for Nuclear Research, near Geneva, Switzerland. It is housed in a 27-kilometre circular tunnel about 100 metres underground.

Inside the LHC, two particle beams travel in opposite directions through separate vacuum pipes. Powerful superconducting magnets guide and focus the beams before they collide. These magnets are cooled to -271.3°C with liquid helium, making them colder than outer space. Thousands of magnets work together to bend, focus, and squeeze the beams, increasing the chances of collision.



Fig. 2: Large Hadron Collider Tunnel

The collisions take place at four major detectors: ATLAS, CMS, ALICE, and LHCb. These detectors record the particles produced during the collisions. Scientists from around the world analyse the data to study the fundamental building blocks of matter and the forces of nature. By recreating conditions that

existed just after the Big Bang, the LHC helps answer some of the deepest questions about the origin and evolution of the universe. Its greatest achievement so far is the 2012 discovery of the Higgs boson, which confirmed a key prediction of the Standard Model of particle physics.

Discovering Earth's Inner Core

In September 1936, Danish seismologist Inge Lehmann made one of the greatest discoveries in geophysics. She published a short but groundbreaking paper titled 'P'. At that time, most scientists believed that Earth had a solid mantle surrounding a completely molten core. Lehmann carefully studied the records of earthquake waves. She noticed that some P-waves (pressure waves) appeared in regions where they should not have reached. This feature puzzled scientists. To explain the observation, Lehmann proposed a bold new idea. She suggested that Earth has a solid inner core surrounded by a liquid outer core.

She relied on careful observations, hand calculations, and detailed analysis of earthquake records. Her discovery completely changed our understanding of Earth's interior and solved one of the biggest mysteries in seismology. Later studies confirmed that the inner core is indeed solid and is made mainly of iron. Today, Inge Lehmann is remembered as one of the pioneers of modern seismology. The seismic boundary associated with her discovery is known as the Lehmann discontinuity.

The Curious Case of the Non-Existent N-Rays

In the early twentieth century, the discoveries of X-rays and radioactivity had inspired scientists to search for new forms of radiation. In 1903, the French physicist René Blondlot announced that he had discovered a new type of radiation. He named it N-rays, after his hometown of Nancy. Blondlot claimed that N-rays could be reflected, refracted, and polarized like light. He also believed that they were emitted by many objects, including metals, living organisms, and even the human brain. His announcement created great excitement. Soon, many researchers reported in journals seeing the same effects. Some scientists even believed that N-rays would become as important as X-

rays. The story took a dramatic turn in September 1904. The American physicist Robert W. Wood visited Blondlot's laboratory to examine the experiments. During a demonstration, Wood quietly removed a key aluminium prism from the apparatus. The prism was supposed to be essential for producing the N-ray effect. However, Blondlot continued to report exactly the same observations. This showed that the reported effects did not depend on the prism at all.

On September 29, 1904, Wood published his findings in the journal *Nature*. He concluded that the observations were not caused by a real physical phenomenon. His report quickly convinced the scientific community that N-rays did not exist.

A New Window on the Expanding Universe

On September 12, 2012, the Dark Energy Camera (DECam), then the world's most powerful astronomical camera, captured its first images at the Cerro Tololo Inter-American Observatory in Chile. The 570-megapixel instrument was designed to collect faint light from distant galaxies, some of which began their journey toward Earth nearly eight billion years ago. By recording this ancient starlight with unprecedented precision, DECam opened a new era in observational cosmology.

The primary goal of the project was to investigate dark energy. It is one of the greatest mysteries in modern physics and believed to be responsible for the accelerating expansion of the universe. Constructed at Fermilab through a collaboration involving 26 research institutions and more than one hundred industrial partners, the Dark Energy Camera became a powerful tool for mapping the large-scale structure of the cosmos and probing the nature of the invisible force that shapes its evolution.

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Sources: <https://www.aps.org/apsnews>

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<https://home.cern/science/accelerators/large-hadron-collider/>

<https://news.fnal.gov/2017/06/50-years-discoveries-innovations-fermilab/>

Finding the Invisible: Using Machine Learning to identify W Bosons in Particle Collisions

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Abstract: The Large Hadron Collider (LHC) at CERN creates 40 million proton collisions each second, producing approximately 1 Petabyte of data daily. Within this massive dataset lie extremely rare particles, including the W bosons, which occurs in only about one collision out of every 300,000. Manual examinations of these events would be impossible, making machine learning crucial. This article presents a Master's project that developed a Gradient Boosted Decision Tree (BDT) classifier using 446,532 simulated CMS collision events to detect $W \rightarrow \mu\nu$ events. When applied to real CMS proton-proton collision data, it successfully detected the distinctive W boson signature: a peak in the transverse mass distribution around 80 GeV. This work addresses one of today's most significant physics puzzles: a 7-sigma (7σ) anomaly in W boson mass measurements reported by the CDF experiment in 2022. This measurement sits 7σ above what the Standard Model predicts. In particle physics, even a 5σ deviation qualifies as a discovery. A 7σ anomaly is remarkable and could indicate dark matter particles or unknown super-symmetric partners affecting measurements through quantum loop corrections. Urgent independent verification using CMS data at the LHC is needed. However, measuring the W boson mass first requires cleanly separating W boson events from background noise, which this project accomplishes.

1. Why do we need Machine Learning in Physics?

Imagine you are searching for a single specific word hidden somewhere in all the books ever written in human history. That is roughly the challenge faced by physicists at the LHC.

The numbers are overwhelming:

- 40 million collisions every second
- 1 Petabyte of raw data daily (equivalent to roughly 250,000 DVDs)
- W bosons appear in only 1 out of 300,000 collisions

No human team could manually examine this data. Traditional analysis relies on “rectangular cuts” – simple rules such as “retain the event only if muon energy exceeds 26 GeV.” While these cuts are physically understandable, they evaluate each measurement separately and overlook subtle correlations. Machine Learning simultaneously learn all

correlations, discovering patterns that humans cannot detect.

From Flowers to Bosons: The Iris Analogy

A classic introductory machine learning problem involves the Iris dataset: using measurements of a flower’s petal length, petal width, sepal length, and sepal width to classify it as one of three species. Our W boson challenge follows the same principle: using 11 measurements from a collision event (muon momentum, missing energy, jet count, etc.) to classify it as “W Boson” or “background”. The main difference lies in scale: Iris contains 150 flowers. We work with 446,532 events. The physics may be more complex, but the machine learning concept remains identical !

2. The W Boson and the 7-Sigma Mystery

The W boson serves as one of nature’s fundamental force carriers. It mediates the weak nuclear force which drives the radioactive decay within atomic nuclei and enables the nuclear fusion that powers our Sun, Stars

could not burn without the W boson. The Standard Model of Particle Physics precisely predicted its mass ($m_W = 80.377 \text{ GeV}$). Any departure from this prediction suggests undiscovered particles or forces. In 2022, Fermilab's CDF experiment reported a W boson mass measurement of:

$$m_W^{\text{CDF}} = 80,433.5 \pm 9.4 \text{ MeV}$$

This is 7 standard deviations (7σ) above the Standard Model prediction. In particle physics, even a 5σ excess is considered a discovery. A 7σ anomaly is extraordinary – it potentially signals dark matter particles or undiscovered supersymmetric partners contributing through quantum loop corrections.

Independent verification at the LHC using CMS data is very important. But before measuring the W boson mass, one must first cleanly select W boson events from the background – which is precisely what this project aims to do.

3. How a W Boson looks like in a Detector ?

The W boson exists for only 3×10^{-25} seconds before decaying. We studied the decay:

$$W^- \rightarrow \mu^- + \bar{\nu}_\mu$$

Detectors capture the muon while the neutrino escapes undetected. The experimental signature includes:

- One high energy muon ($p_T > 26 \text{ GeV}$, well isolated from other particles)
- Missing transverse energy (MET) $> 25 \text{ GeV}$ – the footprint of the invisible neutrino

The key quantity is the transverse mass:

$$m_T = \sqrt{2p_T^\mu \cdot \text{MET} \cdot (1 - \cos \Delta\phi)}$$

where $\Delta\phi$ is the angle between the muon and the missing energy. For a genuine W event, m_T peaks near the W boson mass of 80 GeV – this is the experimental signature. For background events, m_T has no such peak.

4. The Machine Learning Pipeline

This section illustrates the complete analysis pipeline comprising three stages.

Stage 1: Data Preparation

- Read CMS ROOT files
- Apply selection cuts
- Extract 11 physics features
- Assign truth labels

Stage 2: BDT Training

- Split: 60% train / 20% val / 20% test
- Train Gradient Boosted Decision Tree
- Evaluate: AUC and efficiency

Stage 3: Validation

- Apply BDT to real collision data
- Observe m_T Jacobian peak near 80 GeV

The 11 Input Features

Every input feature is available in both simulation and real data – no generator-level (truth) quantities are used. The most important ones are:

- $\Delta\phi$ (μ , MET) – angle between muon and missing energy (most powerful feature!)
- m_T – transverse mass (peaks near m_W)
- n-jets and max b-tag score (an algorithm that identifies jets originating from bottom quarks) – powerfully rejects top-quark ($t\bar{t}$) contamination
- Muon isolation, p_T , η , d_{xy} , d_z
- MET, MET significance

5. Results

How Good is the Classifier?

Table 1 summarizes the performance on the held-out test set of 89,307 events.

An AUC of 0.9849 means : if you randomly pick one true W event and one background event, the model ranks the W higher with 98.49% probability. This is excellent performance.

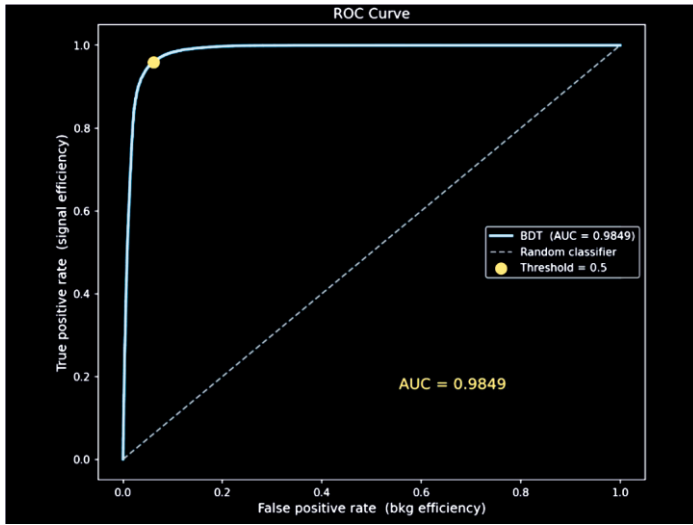
Crucially, the train and test AUC differ by only 0.0008 – the model has learnt the underlying physics, not memorized the training data (no overfitting).

What did the Model learn?

The BDT assigns each feature an importance score. The top features are shown in Table 2.

Table 1. BDT classifier performance on test set

Metric	Value	Scale
AUC-ROC	0.9849	0.5= random, 1.0=perfect
Accuracy	95.0%	-----
Sig. Efficiency	96.0%	True W events found
Bkg. Rejection	93.9%	Background removed
Signal purity	93.5%	Selected events truly W
Overfitting	0.0008	Train – test AUC gap

**Figure 1.** ROC curve for the trained BDT classifier, visually demonstrating the excellent 93.9% background rejection at 96.0% signal efficiency.

The most striking result is that $\Delta\phi$ is by far the most important variable, with 39.7% of the total discriminating power. This is exactly right from physics: in a W boson decay, conservation of momentum forces the muon and neutrino to travel in roughly opposite directions ($\Delta\phi \approx \pi$). Background events have random $\Delta\phi$. The model discovered this fundamental physics property by itself, without being told.

The two jet variables (n jets and b-tag) together account for 52.5% of the classifier’s power. They efficiently remove top quark pair production ($t\bar{t}$) backgrounds, which always produce multiple jets and b-quarks. The

variable muon_dz has exactly zero importance – it contributes nothing and can be removed in future analyses.

Table 2. Importance Score of some features

Feature	Importance
$\Delta\phi$	39.7%
n jets	26.3%
max b-tag score	26.2%
MET significance	3.0%
muon_dz	0.0% (zero!)

The two jet variables (n jets and b-tag) together account for 52.5% of the classifier’s power. They efficiently remove top quark pair production ($t\bar{t}$) backgrounds, which always produce multiple jets and b-quarks. The variable muon_dz has exactly zero importance – it contributes nothing and can be removed in future analyses.

Validation on Real Collision Data

The ultimate test: apply the trained model to real CMS proton-proton collision data from the CERN Open Data Portal – with no truth labels available.

After preselection, 748,054 real collision events entered the classifier. With a BDT score threshold of 0.5, 710,027 events were selected as W boson candidates.

Key Result: The transverse mass distribution of BDT-selected events from real collision data (Figure 2) shows a clear Jacobian peak near $m_T \approx 80$ GeV – precisely where the W boson mass is expected. This is direct experimental confirmation that the machine learning classifier identifies genuine W bosons.

6. Why This Matters: Improvement Over Traditional Methods

Method	Purity	Bkg. Rej.
Simple cuts only	~80%	~75%
Cuts + m_T window	~87%	~85%
Cuts + BDT	~93.5%	~93.9%

The BDT improves signal purity by 6-9 percentage points over traditional methods, while maintaining 96% signal efficiency. For a precision W mass measurement, every percentage point of purity matters – less background contamination means less systematic uncertainty in the final mass value.

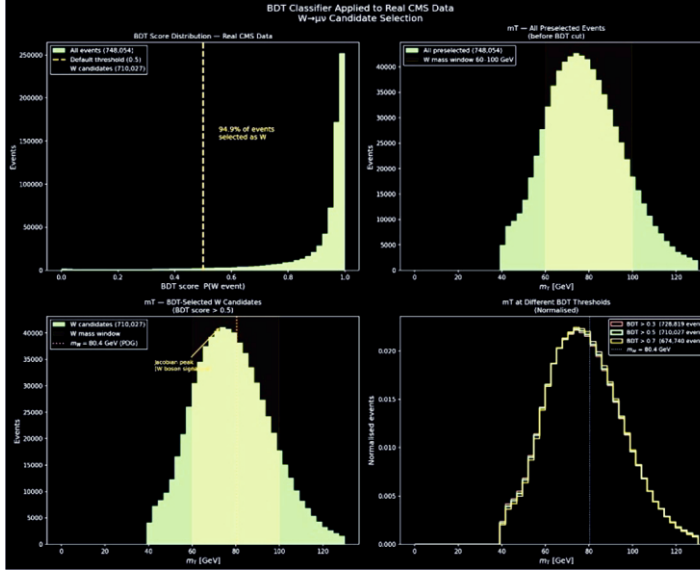


Figure 2. Transverse mass (m_T) distribution of the final selected events from real CMS collision data. The prominent peak confirms the successful isolation of the W boson signal.

7. The Bigger Picture

This project is one step in a larger programme. The immediate next step is to perform a template fit to the m_T distribution of the selected W candidates, extracting the W boson mass value and comparing it with:

- The Standard Model prediction:

$$m_W^{\text{SM}} = 80.357 \pm 0.006 \text{ GeV}$$

- The CDF 2022 measurement:

$$m_W^{\text{CDF}} = 80.4335 \pm 0.0094 \text{ GeV}$$

Beyond this project, machine learning is transforming every aspect of particle physics – from real-time trigger systems that decide in microseconds which collisions to save, to Graph Neural Networks for particle tracking, to Generative AI that simulates detector responses in milliseconds instead of hours.

The High-Luminosity LHC (HL-LHC), expected to begin operations in 2029, will produce ten times more data than the current LHC. Without machine learning, analysing this data will be simply impossible.

8. Conclusion

This work demonstrates that a Gradient Boosted Decision Tree trained on CMS simulation can identify W boson events with an AUC of 0.9849, 96% signal efficiency, and 93.5% purity. The classifier was validated on real collision data by confirming the W boson Jacobian peak near 80 GeV. Feature importance analysis revealed that the azimuthal angle $\Delta\phi(\mu, \text{MET})$ is the single most discriminating variable – a result the model discovered on its own, consistent with the fundamental kinematics of W boson decay.

The project shows that the machine learning is not just useful in particle physics – it is essential. Whether you are a student, a teacher, or simply a curious mind, the tools of machine learning open a window into the tiniest building blocks of our universe.

Acknowledgements

The author Garima thanks Dr. Vipin Bhatnagar for supervision and guidance. CMS Open Data was obtained from opendata.cern.ch.

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Physics even has its lighter sides

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Bohr's horseshoe

Thirty Years That Shook Physics by George Gamow offers an engaging and accessible account of the birth of modern physics, tracing the development of quantum mechanics through clear explanations and vivid historical storytelling. Blending scientific insight with humorous, first-hand anecdotes about legendary physicists, the book provides an enjoyable and insightful prelude to formal studies in modern physics. One such example is related to Niels Bohr. In the book referred above [1] Gamow wrote:

There is another amusing story illustrating Bohr's whimsey [sic]. Above the front door of his country cottage in Tisvilde he nailed a horseshoe, which is proverbially instrumental in bringing luck. Seeing it, a visitor exclaimed: "Being a great scientist as you are, do you really believe that a horseshoe above the entrance to a home brings luck?" "No," answered Bohr, "I certainly do not believe in this superstition. But you know," he added with a smile, "they say that it does bring luck even if you don't believe in it!"

For someone who held a deep conviction in the principle of Complementarity Principle by Niels Bohr, the idea of a horseshoe being both a symbol of superstition and an object of scepticism would indeed be a delightfully fitting paradox. Jokes apart, perhaps It symbolically mirrors the quantum notion that seemingly contradictory perspectives can coexist, making the situation humorously and philosophically satisfying.

Joke of Feynman on non-commutativity

One day in class, Richard Feynman was explaining angular momentum and the curious fact that rotation matrices do not commute. With a mischievous smile, he told a story about William Rowan Hamilton, imagining him strolling through his garden with Lady

Hamilton, the evening calm and reflective. They paused on a bench, and in a sudden moment of passion, Feynman joked, Hamilton realized that $AB \neq BA$ [2]. The class laughed, but the idea stayed. Historically, however, Hamilton's true breakthrough came in 1843 at Brougham Bridge, where he suddenly grasped the noncommutative nature of quaternions and famously carved the relations into stone. Feynman's version, though not factual, turns a deep mathematical insight into a vivid and unforgettable story.

Safecracker Meets Safecracker

During the Manhattan Project, security at Los Alamos was incredibly tight. However, Richard Feynman found the environment quite dull.



Niels Bohr, R. Feynman and W. R. Hamilton

He noticed that the 'top secret' filing cabinets were protected by very simple combination locks. Out of curiosity and for fun, he taught himself how to open them. Soon, he began leaving playful and teasing notes inside his colleagues' high-security safe drawers. One famous note was [3]: "I borrowed document 10-A - The Safecracker." These pranks created a lot of panic among the security officers, who feared that a Soviet spy had broken into the base. In truth, it was just a bored physicist enjoying a new hobby.

In 1975, physicist Jack H. Hetherington finished a high-quality paper on low-temperature physics. He

accidentally used the word 'we' throughout the entire draft. Since he was the only author, a colleague warned that the journal would reject it. Retyping the whole document on a typewriter was a massive chore. To save time, Hetherington simply added his Siamese cat, Chester, as a co-author. He gave the cat the professional name F.D.C. Willard [4].

This stood for *Felix Domesticus, Chester*, sired by *Willard*. The paper was successfully published in the prestigious *Physical Review Letters* [Two-, Three-, and Four-Atom Exchange Effects in bcc ^3He , 35, 1442 (1975)]. When colleagues called to speak with the mysterious Professor Willard, Hetherington joked that the co-author was 'unavailable.'

A Novel Way to protect Nobel Prize

As Nazi troops marched into Copenhagen in April 1940, tension filled the corridors of Niels Bohr Institute. Hidden within its walls were two Nobel Prize medals belonging to Max von Laue and James Franck—sent there for safekeeping to

prevent their confiscation by the regime [5,6]. Their discovery would not only expose defiance but could also endanger lives.

Amid this crisis, the chemist George de Hevesy acted with quiet ingenuity. Rejecting the idea of burying the medals, he chose a more subtle path. In his laboratory, as soldiers advanced outside, he dissolved the solid gold medals in aqua regia, a powerful mixture of nitric and hydrochloric acids. Slowly, the gleaming symbols

of scientific honour vanished into an ordinary-looking orange solution. He then placed the beaker casually on a shelf—so unremarkable that it escaped the notice of the Nazi search.

Years later, after the war had ended, Hevesy returned. The bottle still stood where he had left it, untouched. From that quiet solution, he recovered the gold and sent it back to the Royal Swedish Academy of Sciences. The medals were recast and restored to their rightful owners - a remarkable story in which chemistry, presence of mind, and a touch of audacity succeeded in outwitting an occupying force.

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C K Majumdar Memorial Summer Workshop in Physics –2026 Educators

The Workshop was held from 22nd to 28th July 2026 at the S N Bose National Centre for Basic Sciences (SNBNCBS), Kolkata. It was jointly organized by RC-15 and SNBNCBS with the objective of exposing the participants to recent advances in physics through lectures delivered by eminent scientists, laboratory visits, and hands-on experimental sessions. Apart from the colleges and universities of West Bengal the participants also came from the institutions from U.P, Punjab and Bihar. They belonged to the outgoing 3rd year B.Sc. (Physics) and PG (Physics) classes.

Day 1: 22nd July 2026

The workshop commenced with an inaugural session that began with a warm welcome address delivered by Prof. Rajib Kumar Mitra, Dean of Academic Programme, SNBNCBS, and Dr. Bhupati Chakraborti, Former GS of IAPT. They welcomed the participants and emphasized the importance of such workshops in fostering scientific curiosity and strengthening the interaction between researchers, teachers, and students. Following a tea break, the first technical session, chaired by Dr. Surajit Chakrabarti, began with a lecture entitled "**A Tale of Two (or More) Qubits – Part I**" by Prof. Ananda Dasgupta of IISER Kolkata. The lecture provided a lucid and comprehensive introduction to the fundamental concepts of quantum computing, familiarizing the participants with qubits, quantum superposition, and the basic principles underlying quantum information processing.

The second lecture of the session was delivered online by Prof. S K Roy of IIT Kharagpur on "**Light–Matter Interactions in Semiconductors.**" He discussed recent advances in semiconductor physics, the rapid growth of artificial intelligence and its associated energy challenges, low-power electronic devices, silicon photonics, solar cells, and several other emerging technologies. The lecture effectively demonstrated how semiconductor research continues to drive modern technological innovations.

Following the lunch break, the afternoon session was devoted to practical activities. The participants were

divided into Group A and Group B. One group visited several advanced research laboratories where they were introduced to sophisticated instruments such as the **Transmission Electron Microscope (TEM)**, **Field Emission Scanning Electron Microscope (FESEM)**, **X-ray Diffraction (XRD)**, and **X-ray Photoelectron Spectroscopy (XPS)** systems. Meanwhile, the other group performed hands-on experiments in the M.Sc. laboratory, (C K Majumdar Laboratory) including the **Ultrasonic Interferometer**, **Millikan Oil Drop Experiment**, **Optical Fiber Experiment**, and the **Franck–Hertz Experiment**. The practical session provided valuable exposure to both modern research facilities and classical physics experiments. The groups swapped after two working days so that every participant could gain equal exposure to both research facilities and experimental work.

Day 2: 23rd July 2026

The second day's programme commenced at 9:30 a.m. with the first technical session chaired by Prof. G P Das, a very senior scientist from TCG Crest. The opening lecture was delivered by Prof. Shyamal Kumar Bhadra of the Indian Association for the Cultivation of Science (IACS), Kolkata, on "**Fascinating Science in Colonial India.**" Through numerous historical examples, he highlighted the remarkable scientific achievements of Indian scientists during the colonial period and inspired the participants with the rich legacy of Indian science. The second and third lectures were delivered by Prof. Siddhartha Lal of IISER Kolkata on "**Quantum Matter: Ginzburg–Landau–Wilson and Beyond.**" He introduced modern concepts of quantum matter and discussed recent theoretical developments in condensed matter physics. Beginning with the conventional Ginzburg–Landau–Wilson framework, he explained its limitations and described several emerging ideas that extend beyond it. His exceptional clarity of presentation, deep insight into the subject, and engaging style of expression captivated the

audience throughout the session. The participants greatly appreciated his ability to explain highly sophisticated concepts in a simple and accessible manner. Following the lunch break, the practical session resumed. This time, Group A visited the remaining research laboratories while Group B continued performing the hands-on experiments in the laboratory.

Day 3: 24th July 2026

The third day's programme commenced at 9:30 a.m. under the chairmanship of Dr. Bhupati Chakrabarti. The first lecture was delivered by Prof. Priya Mahadevan of SBNBCBS on **"Simple Models to Understand Phenomena at the Nanoscale."** She illustrated how relatively simple theoretical models can successfully explain complex physical phenomena occurring at the nanoscale, thereby emphasizing the elegance and predictive power of theoretical physics.

After the tea break, Prof. Ananda Dasgupta delivered the second part of his lecture, **"A Tale of Two (or More) Qubits – Part II."** He explained the EPR thought experiment, Bell's theorem without inequalities, quantum gates, and quantum teleportation with remarkable clarity. The lecture further strengthened the participants' understanding of the fascinating principles of quantum mechanics and quantum information science. The third lecture of the day was delivered by Dr. Tapas Baug of SBNBCBS on **"Planets outside the Solar System."** Beginning with our cosmic address, he introduced the participants to the fascinating field of exoplanet research, various techniques used to detect planets beyond our solar system, and the structure of the observable universe. His lively presentation made the lecture both highly informative and thoroughly enjoyable.

After lunch break, the practical session started like previous two days.

Day 4: 25th July 2026

The fourth day's programme began at 9:30 a.m., with the first technical session chaired by Dr. Achintya Pal, a senior member of IAPT. The first lecture was delivered by Dr. Brato Chakraborti of ICTS–TIFR, Bengaluru, on **"Introduction to Hydrodynamics."**

He introduced the fundamental principles of fluid dynamics and demonstrated their applications in everyday phenomena such as swimming, fluid flow, and drag force. Through simple examples and lucid explanations, he made a mathematically rich subject accessible and enjoyable for the participants.

Following the tea break, Dr. Samudra Roy of IIT Kharagpur delivered two lectures entitled **"Playing with Optical Frequencies – Part I"** and **"Playing with Optical Frequencies – Part II."** He introduced the fascinating world of nonlinear optics, discussing second- and higher-order harmonic generation, nonlinear optical waveguides, super continuum generation, optical solitons, and their wide-ranging technological applications. The lectures successfully combined theoretical concepts with practical significance and were highly appreciated by the audience.

The second technical session commenced after lunch, at 2:30 p.m. under the chairmanship of Dr. Saswati Dasgupta, a Senior Member of IAPT. The first lecture of the afternoon was delivered by Dr. Sudipta Sasmal of the Institute of Astronomy, Space and Earth Science, Kolkata, on **"Innovative Cross-Disciplinary Pathways for Disaster Risk Reduction."** He highlighted how interdisciplinary scientific research contributes significantly to disaster prediction, preparedness, and mitigation.

The final lecture of the day, **"Building Quantum Circuits and Algorithms,"** was delivered by Prof. Sabyasachi Mitra. This interactive hands-on session enabled participants to construct quantum circuits and implement basic quantum algorithms using their own laptops. The practical nature of the session greatly enhanced the participants' understanding of quantum computation and made it one of the most engaging sessions of the workshop.

Day 5: 26th July 2026

The morning session commenced at 9:30 a.m. under the chairmanship of Dr. Bhupati Chakrabarti. The first lecture was delivered by Dr. Avijit Chowdhury of SBNBCBS on **"Artificial Synapses: Mimicking the Brain with Electronics."** He introduced the fascinating field of neuromorphic electronics,

explaining how artificial synapses—advanced nanoscale electronic devices—can emulate the biological connections between neurons. He described how these devices function simultaneously as processors and memory units, enabling parallel data processing and adaptive learning similar to the human brain. The lecture exposed the participants to an exciting and rapidly emerging area of research, generating considerable interest among them.

Following the tea break, Prof. Atindra Nath Pal delivered a lecture entitled **"Can Electrons Interfere Like Light?"** Using the **Aharonov–Bohm effect** as the central theme, he demonstrated how charged particles such as electrons exhibit quantum interference even in regions where only electromagnetic potentials are present. Through clear explanations and elegant demonstrations, he illustrated one of the most intriguing phenomena in quantum mechanics.

The third lecture of the session was delivered by Dr. Brato Chakraborti, who presented **"Life in Moving Fluids."** He demonstrated how the principles of hydrodynamics can be applied to understand various biological systems and natural phenomena. His lively presentation, enriched with real-life examples, held the audience's attention throughout the lecture.

Following the lunch break, the afternoon session (2:30 p.m.–5:30 p.m.) featured a **Hands-on Demonstration of Innovative Experiments Using Smartphone Sensors and Applications**. The session was conducted by Dr. Pradipta Panchadhyayee of Prabhat Kumar College, Contai Mr. Sanjoy Kumar Pal, Physics teacher and Sri Papun Mondal, Chemistry teacher of Anandapur High School, Paschim Medinipur, assisted by Mr. Mrinal Kanti Pal, a PG student. The participants performed a series of low-cost yet innovative experiments using smartphone sensors to investigate various physical phenomena. The session beautifully demonstrated how modern mobile technology can be effectively integrated into physics teaching and laboratory practice, making experimental learning more accessible, interactive, and engaging.

Day 6: 27th July 2026

The session-I of the day began at 9:30 am under the

chairmanship of Dr. Surajit Chakrabarti, a Senior member of IAPT. At the very beginning of this session, the Director of SNBNCBS, **Prof. Tanusri Saha Dasgupta**, warmly addressed the participants and interacted with them. She encouraged the students to pursue higher studies and research in physics and introduced them to the academic and research facilities available at the S. N. Bose National Centre for Basic Sciences.

After this interactive session, **Prof. Atindra Nath Pal** of SNBNCBS delivered a lecture on **"Building a Perfect 1D Atomic Chain."** He began with the elementary concept of **diffusive transport**, introduced by Paul Drude, and gradually led the audience to advanced topics such as **quantum interference effects** and **weak localization in graphene**. His systematic presentation enabled the participants to appreciate the evolution of transport phenomena from classical to quantum regimes. The second lecture was delivered by **Prof. Sakuntala Chatterjee** of SNBNCBS on **"Run and Tumble Motion using Reinforcement Learning (RL)."** She explained how reinforcement learning can be applied to study models inspired by bacterial chemo taxis. The lecture highlighted the interdisciplinary application of physics to biological systems and provided students with valuable insights into emerging areas of research at the interface of physics, biology, and artificial intelligence.

The final session before the lunch break was devoted to an interactive discussion. The participants enthusiastically interacted with **Prof. Avijit Chowdhury**, who patiently answered their questions and shared his experiences, making the session both informative and inspiring. The post-lunch session was dedicated to the laboratory activities, where the participants continued their hands-on experiments and visited the research laboratories.

Day 7: 28th July 2026

The final day of the workshop began at 9:30 am and chaired by Dr. Saquib Shamim of SNBNCBS. The session started with an inspiring lecture by, **Dr. Bhupati Chakrabarti**, titled **"How the Physicists Made a Year Unique in the History of Nobel Prize."** Rather than focusing on a technical subject,

he presented a fascinating overview of the remarkable contributions of physicists to diverse fields of science. His lecture centered on the Nobel Prizes awarded in **1969** in Physics, Physiology or Medicine, and Economics. While **Murray Gell-Mann** received the Nobel Prize in Physics, one of the recipients of the Nobel Prize in Physiology or Medicine was a biophysicist. Furthermore, 1969 marked the introduction of the Nobel Prize in Economic Sciences, and one of its first recipients was also a physicist. Through these examples, Dr. Chakrabarti beautifully illustrated the far-reaching impact of physicists and the interdisciplinary nature of scientific research.

The second and concluding lecture of the workshop was delivered by **Prof. Punyabrata Pradhan** of SNBNCBS on "**Hidden Order in Disorder: How Nature Organizes Matter Beyond Equilibrium.**" Adopting the traditional chalk-and-board method, he explained complex concepts in a simple and engaging manner. The lecture evolved into a lively interactive session, reflecting the keen interest and active participation.

Before lunch, from 12:30pm to 1:30pm, there was a students' presentation session, where participant students delivered their presentations on diverse areas,

including astrophysics, materials science, quantum entanglement, and other frontier topics, showcasing the broad academic interests of the participants which continued up to post lunch session. Before going for the lunch, a **group photo session** was held on the lawn of SNBNCBS. **Prof. Suman K. Roy**, a senior member of IAPT, captured memorable photographs of the participants, invited speakers, and IAPT members.

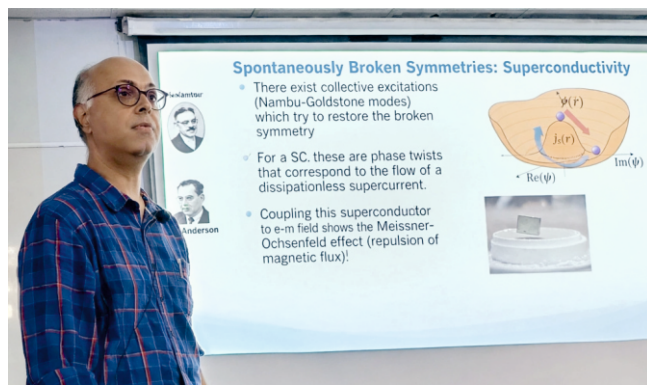
The workshop concluded with the **Valedictory Session**, during which the President of IAPT, **Prof. P K Ahluwalia**, and the GS, **Prof. Rekha Ghorpade**, joined online. They congratulated the participants, shared their valuable thoughts, and encouraged the students to continue their pursuit of scientific excellence. The final programme of the workshop was the distribution of participation certificates by the senior members of IAPT. The **Workshop** concluded with a formal **vote of thanks**, by Dr. Bhupati Chakrabarti, bringing to a close of a week-long enriching lecture, stimulating discussions, hands-on experimental sessions, and meaningful academic interactions which left a lasting impression on all the participants.

Lipika Santra
Sukla Chakraborty





Demonstration in M.Sc. Lab



Presentation of Prof. Siddhartha Lal

Report (RC-12A)

Regional Essay Writing Competition

The RCEWP has been a signature event of RC12A since 2022, steadily maturing in both participation and evaluation quality. The essays received were largely original and appreciated by the judges.

A challenge this year was the wide range of topics students chose, which made evaluation more demanding and slower. A fair judgement was ensured by averaging marks awarded independently by different judges. All essay writing and evaluation work was carried out from home, with communication handled through WhatsApp and email.

To enrich the students' learning, we noted with interest how some essays drew inspiration from scientific narratives—one student quoted Schrödinger's idea that *"life survives by exporting internal disorder,"* using it metaphorically to describe how societies adapt. Another referred to the discovery of DNA as *"a three-dimensional jigsaw puzzle,"* echoing Watson and Crick's model-building approach. These small but thoughtful inclusions showed growing scientific curiosity among participants.

One concern is that participation tends to get localised to certain schools and colleges. This is primarily because some teachers take a keen interest in our posters and brochures, motivate their students, and ensure active participation. Earlier, entries came from only two or three institutions, but this year the reach expanded to several schools and colleges. Teacher entries are sent directly to the central NCEWP coordinator, while only the student essays—school and college toppers—are forwarded for participation

in NCEWP.

In RCEWP 2026, publicity was widespread, and a few students from Tamil Nadu also submitted essays, although the competition was announced as a state-level event for Karnataka. Their essays were evaluated by RC12A and then forwarded to RC13 (Tamil Nadu) for appropriate prize declaration and recognition.

Our results have been announced, and the Prize Distribution Ceremony has been postponed to the end of August. Beautiful certificates are designed and will be awarded ceremoniously, scheduled on 25 Aug 2026 at the BN Chandrika Memorial Events.

We express our sincere gratitude to the judges—Dr. Usharani D, Ex-Principal, MES Arts, Commerce and Science College, Bengaluru, and Prof. Saritha Bai, HOD of English and Ex-Principal, Maharani Lakshmi Ammanni PU College, Bengaluru

for their dedicated effort, careful evaluation, and faithful adherence to the rubric. The Convener, Dr. Manu S, EC Member of RC12A and Lecturer in Physics, Amrita Vidyalayam and PU College, Bengaluru, has managed the entire process efficiently, and his publicity skills are commendable.

As one essay insightfully noted, *"scientific progress often begins with a single idea capable of transforming an entire worldview."* In the same spirit, RC12A remains committed to strengthening this academic practice and aims to improve further each year.

Sarmistha Sahu
Secretary

Prize Distribution Ceremony – RCIEP & Experiment Time 2026

Date: 27th July 2026 **Mode:** Online (Zoom) **Organized by:** IAPT RC12A & Ammanni Anveshika

Chief Guest: Padma Shri Prof. H C Verma

1. Introduction

The RCIEP & Experiment Time 2026 Prize Distribution Ceremony was held online on 27 July 2026, bringing together nearly **50 participants**, including students, teachers, evaluators, parents, and members of IAPT. The programme celebrated scientific curiosity, creativity, and hands-on innovation demonstrated by young learners across Karnataka and nearby regions.

The event was anchored by Ms. Minal Gupta, whose warm and vibrant presence set an engaging tone for the evening.

2. Overview of RCIEP & Experiment Time 2026

Prof. Sarmistha Sahu, Secretary RC12A, presented an overview of the two major initiatives—RCIEP 2026 and Anveshika Experiment Time—highlighting the objectives, participation, and evaluation process. She also displayed photographs from the 19th July events, illustrating the sincerity and effort of the students and facilitators.

“Students engaged deeply with new ideas, made first-hand observations, and experienced the excitement of experimental physics.”

Her address emphasized the spirit of inquiry that drives both competitions and the role of evaluators in nurturing scientific thinking.

3. Reflections by Teachers & Evaluators

The evaluators' panel shared thoughtful insights on student performance and the value of hands-on experimentation.

- Prof. Somasekara, Jury Member – RCIEP, shared a brief report of his contribution, although he was unable to attend the meeting.
- Prof. K M Raghavendra, EC Member & CEO, MES Group, could not be there for personal reasons).
- Ms. Uma M K, Evaluator – Experiment Time, shared her reflections.

- Ms. Richa Kaul, Coordinator – RCIEP (could not be present, sent her feedback by WhatsApp)

Ms. Uma M.K.'s feedback was especially touching and descriptive, reflecting the depth of student engagement.

4. Student Interaction

Selected students shared their experiences, inspirations, and learnings from the competitions. While Varun and Aarav's mother spoke encouragingly, Spandana—a shy participant—was supported by her headmaster, who spoke highly of the event and its impact on rural students.

“With steady focus and dignity, the children complete the experiments.”

Their reflections highlighted how the competitions strengthened confidence, curiosity, and scientific temperament.

5. Address by Chief Guest

The most awaited segment of the evening was the address by Padma Shri Prof. H. C. Verma, introduced gracefully by Ms. Arushi Gupta, an alumnus of Ammanni Anveshika.

Prof. Verma's interaction with students was crisp, bold, and deeply inspiring. He encouraged learners to think beyond textbooks, embrace experimentation, and cultivate scientific curiosity.

6. Role of Anveshikas in Nurturing Scientific Curiosity

Mr. Dinesh Sharma, National Coordinator of NANI, offered a succinct and insightful summary of the students' performance. He highlighted the pivotal role played by Anveshikas across India in reaching learners at multiple levels and fostering curiosity-driven, experiential learning in science.

7. Announcement of Prize Winners

The prize winners of RCIEP 2026 and Experiment Time 2026 were announced by Ms. Uma M K (soft

copies were displayed).

Participants received:

- **Certificates**
- **Pre-receipts for prize money** (to be validated and returned)

Prize money transfers will follow after completion of documentation.

8. Closing Note

Prof. P K Ahluwalia, President of IAPT, delivered an exhaustive and soothing closing note, outlining the contributions of IAPT to society and encouraging students to join as student members.

9. Felicitation & Acknowledgements

A comprehensive felicitation address was delivered by Secretary RC12A, acknowledging:

- The Ammanni Anveshika EC team
- LEPTON facilitators
- RCIEP jury and organizers
- Zoom facilitation team
- School management, teachers, and students

- IAPT leadership

“Thank you, each one of you, for being part of this journey. May the sparks we lit today continue to shine brightly...”



Mr. Dinesh Sharma, National Coordinator, NANI

10. Conclusion

The ceremony concluded with the **National Song – Vande Mataram**, sung melodiously with background music marking a dignified end to the celebration.

Sarmistha Sahu

Report (RC-04)

Online Lecture

Semiconductor Optical Detectors: An Overview

Aligned with the national vision of **India Semiconductor Mission 2.0**, and NEP-2020's vision of promoting Academia -Research collaboration, the Department of Physics, Bareilly College, Bareilly, in collaboration with RC-04, Uttar Pradesh, organized an online lecture entitled '**Semiconductor Optical Detectors: An Overview**' on 5th August, 2026. The programme aimed to disseminate contemporary knowledge in semiconductor optoelectronics and cultivate scientific awareness among students, research scholars and faculty members.

The keynote lecture was delivered by **Dr. Sona Das**, Scientist E, **Semiconductor Laboratory, Chandigarh**. Presenting a comprehensive overview, Dr. Das explained the operating principles, device architecture, classifications and performance

parameters of semiconductor optical detectors. He further delineated their indispensable applications in optical communication, biomedical diagnostics, defence surveillance, remote sensing, industrial automation and space technology, while highlighting recent advances and future research opportunities.

The programme was conducted under the patronage of Prof. O P Rai, Principal, Bareilly College, with Shri Devmurti, Secretary, Bareilly College Management Committee, as Chief Patron. Prof. B P Tyagi, National Coordinator, IAPT Examinations, remained virtually present and extended academic support. The event was coordinated by Prof. Ritu Agrawal, Head, Department of Physics, and efficiently organized by Prof. Sundar Singh, Organizing Secretary & EC Representative. All faculty members from the Physics

Department extended active support in organizing the event. HOD's of various science departments of the College also remained present.

The lecture attracted an enthusiastic audience comprising faculty members, research scholars and students from Bareilly College and several other institutions. A total of 75 participants attended online,

while 47 participated offline. The interactive discussion that followed reflected the participants' intellectual curiosity, with Dr. Das addressing diverse technical queries with exceptional clarity. The programme ended on a positive note with the formal vote of thanks proposed by the Prof. Ritu Agarwal.

Sunder Singh



Moon Landing Day Celebration

Report (RC-21)

The Goa Regional Council, in collaboration with the Goa Science Centre and Planetarium, organized a special programme to commemorate Moon Landing Day on 18th July 2026. The programme was organized to commemorate the historic Apollo 11 mission and to promote scientific awareness, curiosity, and interest in space science among students and the general public. Approximately 120 school students and teachers attended the programme.

The programme was graced by Mr. Abhimanyu Belavi, Project Head, Goa Science Centre, and Ms. Mamta Singh, Producer of the documentary **“All That Matters”**.

The programme commenced with a scientific lecture delivered by Dr. Reshma Raut Dessai on **“Apollo 11: A Historic Milestone in Space Exploration”**. The talk highlighted the historical significance of the Apollo 11 mission, which culminated in the first

human landing on the Moon in July 1969. The talk provided an overview of the scientific and technological challenges associated with the mission and discussed the contributions of astronauts Neil Armstrong, Edwin “Buzz” Aldrin, and Michael Collins. It also emphasized the role of physics, engineering, mathematics, technological innovation, and human curiosity in achieving one of the most remarkable milestones in the history of space exploration.

The lecture was followed by the screening of a documentary on the life of Dr. Rohini Godbole, an eminent Indian physicist and science advocate titled **“All That Matters”**. The late Dr. Rohini Godbole was one of India's most distinguished theoretical physicists and a globally acclaimed authority in high-energy particle physics. Renowned for her intellectual brilliance, clarity of thought, and unwavering

commitment to scientific inquiry, she combined pioneering research with a deep passion for mentoring young scientists and promoting the participation of women in science.

The documentary *All That Matters* is a fitting tribute to this extraordinary woman. Directed by the acclaimed award-winning filmmaker Mamta Singh. The film chronicles the challenges Dr. Godbole overcame, the questions that drove her relentless pursuit of knowledge, and the exceptional contributions she made to science. It beautifully



interweaves her professional achievements with her personal journey, presenting a compelling portrait of a woman whose life was defined by intellect, courage, determination, and compassion.

The programme concluded with the inauguration of the Human Gyro exhibit at the Goa Science Centre. The interactive exhibit provides visitors with an opportunity to experience rotational motion and explore fundamental principles of physics through direct participation.



Reshma Raut Dessai

Report (RC-16)

Experimental Physics to the Doorsteps of Students in Bolangir, Odisha

The Indian Association of Physics Teachers (IAPT), Regional Council-16 (Odisha) successfully organised a series of Experimental Demonstration Workshops on “Learning Physics through Experiments (LEPTEx)” in Bolangir district of Odisha, bringing the wonder and rigour of experimental physics closer to students and teachers in a region where such opportunities remain relatively limited.

The workshops were conducted on 3 August 2026 at Radha Raman Nagar Nodal Upper Primary School, Bolangir; 4 August 2026 at Roshni Public School, Bolangir; and 6 August 2026 at Saraswati Shishu Vidya Mandira, Kadampada, Bolangir. The programmes were organised under the patronage of Shri Alok Kumar Patel, OAS (SB) Sub-Collector-cum-SDM, Bolangir, with the active collaboration of Bigyan Sahitya Parishad, Bolangir.

A distinguished senior member of IAPT, Prof. (Dr.)

Abhimanyu Mishra, Retd. Principal, Rajendra College, Bolangir, and Executive Committee Member, IAPT, RC-16, graced all three programmes and conducted an extensive series of experimental demonstrations. Through nearly 60 innovative physics experiments, he illustrated fundamental concepts relating to electricity, magnetism, reflection, refraction, diffraction, wave motion, force, energy and mechanics.

The demonstrations transformed what often remains confined to the pages of textbooks into visible, tangible and intellectually compelling experiences. Abstract physical principles emerged before the learners as phenomena that could be observed, questioned, tested and understood. The workshops thus sought not merely to teach physics, but to restore to it the spirit of inquiry upon which science itself is founded.

The sessions generated lively participation among students and teachers. Questions, observations and discussions accompanied the demonstrations, reflecting the scientific curiosity awakened by direct engagement with physical phenomena. The approach underscored a fundamental truth of science education: when the hand performs what the mind has conceived, knowledge ceases to be a memorised proposition and becomes an experience.



The school administrations extended their full cooperation and encouragement, ensuring active participation and a conducive academic environment throughout the programmes. Their support was instrumental in carrying the spirit of experimental learning into the classrooms.

The LEPTEX initiative of IAPT–RC-16 represents a continued commitment to democratising science education and taking experimental physics beyond conventional academic centres. By bringing demonstrations, experimentation and scientific dialogue directly to schools, IAPT seeks to cultivate among young learners the habits of observation, reasoning, verification and wonder that constitute the foundation of scientific temper. The Bolangir programmes stand as a modest yet meaningful step in this larger journey.



For science begins with a question; experiment gives that question a voice; and discovery becomes the light by which the next generation learns to see the world.

Rita Paikary

Report (RC-13)

Infusing Curiosity: A One-Day Workshop for Science Teachers

These are testing times for science teachers. The academic pressure on one side to deliver more and the challenge of adapting to rapidly evolving landscape of instruction with AI. In the prevailing uncertainty human connection remains quintessential for teachers to stay curious and motivated. This is the sentiment that underpinned the recently concluded workshop “*Infusing Curiosity: A One-Day Workshop for Science Teachers*” conducted by the Department of Physics, Madras Christian College jointly with Indian Association of Physics Teachers, Regional Council-13 (Tamil Nadu and Pondicherry). The workshop was

held on 10th Aug 2026 and it saw an enthusiastic participation from 41 science teachers from in-and-around Chennai. Some of the most seasoned experts were the resource persons of the workshop who deftly blended their talks with beautiful demonstrations and their curiosity provoking thoughts.

The workshop started-off with a formal welcome address by Prof. Johanan Christian Prasana, Associate Professor & Head, Dept. of Physics, Madras Christian College, followed by an introductory remark by Dr. N. Nirmal Thyagu who was the organizer of the workshop. The first talk was by Prof. Govind

Krishnaswami, Dept. of Physics, Chennai Mathematical Institute who talked on “Foundations of Newtonian Mechanics”. In his talk, Prof. Krishnaswami clearly laid out the foundational concepts such as homogeneity of space and time, isotropy of space, continuous and discrete symmetries of Newtonian space. He further connected the continuous symmetry with a conserved quantity in a system through the Noether's theorem. Prof. Krishnaswami brought to fore the discussion on Brownian motion and explained how pollen particles' trajectories fail to fulfil the deterministic laws of mechanics, viz, they are not twice differentiable functions of time. He further stated how Einstein's theory on Brownian motion solved the problem using probabilistic approach.



Prof. Govind Krishnaswami



Prof. H. S. Mani



Group picture with Prof. T. S. Natarajan

The second session was led by Prof. T. S. Natarajan (Retd.), Dept. of Physics, IIT Madras, who enthralled the audience with wide ranging demos that include Bernoulli's theorem, conservation of angular momentum, Tesla tube, and many electronics kits. Prof. T. S. Natarajan not only showed the demons but also provided out a number of hands-on physics kits to the participant teachers to try it out for themselves. He pointed out that he has developed these kits on his own by trial-and-error over many years, and encouraged teachers to developing and using such kits as ideal teaching aids. In a humour laced talk he quipped that if an experiment works in the first attempt then something is wrong with it! By which he stressed the point that one learns by making mistakes, and teachers should give freedom to students to make mistakes and learn from the mistakes.

In the third session, Prof. H. S. Mani, Visiting Professor, Dept. of Physics, Chennai Mathematical Institute, gave an insightful talk on “Physics of Information”, wherein he outlined the fundamental concepts in a clear and coherent fashion. Following which he and his associate, Ms. Lisha Krishan, used ExpEYES science and interfacing kit to demonstrate a few simple experiments that can be done in a classroom or a laboratory. The participants showed a great zeal and enthusiasm throughout the workshop.

N. Nirmal Thyagu

Report (RC-17)

Celebration of National Space Day 2026 at Salbari College, Assam

Salbari College celebrated National Space Day 2026 on 22 August 2026, one day ahead of the official date of 23 August, with great enthusiasm and participation from students and faculty members. The programme

was organized in collaboration with the Indian Association of Physics Teachers (IAPT-RC17) and the IQAC Cell, Salbari College, with the objective of creating awareness among young students about space

science, India's achievements in space exploration, and the future opportunities in the field.



The programme was inaugurated by Dr. Jagat Ch. Basumatary, Principal, Salbari College. In his inaugural address, he appreciated the initiative and emphasized the importance of developing scientific curiosity and a spirit of exploration among students, particularly those studying in institutions located in rural and remote areas. The event coordinator, Dr. Pritam Das, Assistant Professor, Department of Physics, Salbari College, explained the significance of National Space Day and highlighted the remarkable progress made by India in the field of space science and technology. He motivated the students to develop an interest in science, astronomy and space exploration and encouraged them to pursue new ideas and research in these emerging areas.

The programme also featured an invited lecture by Dr. Debabrat Mahanta, Assistant Professor, Pragijyotish College, who attended as the resource person. He delivered an informative and inspiring speech on India's achievements in space exploration, with particular emphasis on the historic Chandrayaan-3 mission. He explained in detail the successful landing of Chandrayaan-3 near the southern polar region of the Moon on 23 August 2023, a landmark achievement of the Indian Space Research Organisation (ISRO). His presentation helped the students understand the scientific significance of the mission, the challenges involved in lunar exploration, and the importance of India's achievement for future space research. Students enthusiastically participated in the discussion and raised a number of simple yet thoughtful and curious questions. The experts responded to the questions patiently and explained the

concepts in an accessible manner. The interaction was particularly valuable for the younger participants, as it encouraged them to overcome hesitation in asking questions and helped them understand scientific concepts through direct discussion with experts. The session created an engaging environment and further increased the students' interest in space science and exploration. The programme was attended by Dr. Dulen Basumatary, Vice-Principal, Dr. Sankang Basumatary, IQAC Coordinator; Dr. Laithun Baro, Assistant Coordinator, IQAC; Dr. Priyanka Das, head of the department, Physics along with the members of the teaching and non-teaching staff of Salbari College, and a large number of students.



Apart from the students from the host institution, students from nearby institutions such as Salbari Higher Secondary School, Good Shepherd National School, and St. Xavier's School, Salbari, also participated enthusiastically in the programme. Following the awareness programme, two competitive events were organized to encourage creativity, scientific thinking and active participation among students. The participants were divided into two groups: Group A: All undergraduate students and Group B: Students from Classes VIII to XII. The competitions included a Poster Making Competition and a Science Model Exhibition. Students enthusiastically presented their creative ideas and scientific models related to space science, astronomy, technology and scientific innovation. The winners of

the competitions were felicitated with cash prizes, trophies and certificates in recognition of their creativity and outstanding performance.

The celebration was particularly meaningful because Salbari College is situated in a remote area of Assam, where students may have limited opportunities to interact directly with experts in advanced fields of science and technology. The programme provided

them with an opportunity to learn about India's achievements in space exploration, interact with a resource person, and express their own scientific ideas through creative activities.

The event concluded with a sense of inspiration and renewed enthusiasm among the students to learn more about space science, astronomy, scientific research and India's future missions in space exploration.



Pritam Das (Salbari College)
In collaboration with: RC-17

Report (Anveshika)

Teachers interaction workshop at La Martiniere for Boys' School, Kolkata

Adarsha IAPT Anveshika and Anuranan-Science Awareness, a non-profit Society, jointly organised a Five-Hour teachers interaction workshop at La Martiniere for Boys' school on 22 August 2026. Mr. Nani Gopal Mondal and Mr. Debmalya Sen from Adarsha IAPT Anveshika conducted the workshop as resource persons.

Total 40 teachers from 23 reputed schools attended the workshop. The aim of the workshop was to equip teachers with hands-on physics teaching and

experiential learning, laid out by NEP curriculum in classroom. A number of experiments from different physics topics were demonstrated; teachers actively participated and discussed on the basis of demonstrations. Dr. Bidhan Kumar Bhaumik, Retd. Scientist, Bhabha Atomic Research Centre,

Kolkata & Secretary, Anuranan Science Awareness Society, inaugurated the workshop with his valuable thoughts.

The sessions were interactive live physics demonstrations. On basic concepts on force, optics and electromagnetism experiments were demonstrated, Teachers participated actively in discussions. Enjoyed the sessions and basic concepts and doubt were cleared with myth breaking experiences. Mr. Keshav Kothari and Ms. Madhumita



Mazumder members of Adarsha IAPT Anveshika demonstrated some spectacular experiments on optics and electromagnetism.

A certificate and experiment kit box is provided to all the participants for implementation the same in classroom.



Debmalya Sen

Report (RC-12A)

B. N. Chandrika Memorial Events 2026

The B. N. Chandrika Memorial Events 2026, jointly organized by Vijaya Pre-University College, Jayanagar, Bengaluru, and IAPT-SRC 12A, were held on 25 August 2026 with enthusiastic participation from students and teachers from colleges across Bengaluru.

The inaugural programme was graced by Dr. M. K. Raghavendra, Chief Guest, with Prof. H. S. Balakrishna and Prof. K. M. Raghavendran as Guests of Honour. Prof. P. C. Nagaraja presided over the programme. Dr. Raghavendra delivered an engaging and thought-provoking lecture on the importance of physics, inspiring students to appreciate the relevance of physics in science, technology and everyday life.

The second session featured the Physics Written Quiz and Physics Lecture Contest. The quiz received an overwhelming response, with 37 teams from 20 colleges participating. The Lecture Contest witnessed one of the best responses in recent years, with 47



M.K. Raghvendra connecting with young minds.

students from 21 colleges taking part. The contest was judged by Prof. Sumukha, Surana College, and Prof. Pramod Kumar, BMS College for Women. Lunch was provided to all participants.



Honouring the legacy of B.N. Chandrika with awards

The day concluded with the Valedictory and Prize Distribution Ceremony, graced by Prof. Somashekhara S. and Prof. T. Balakrishna Adiga, Secretary, BHSHEs, with Prof. K. M. Raghavendran presiding. Prizes were awarded to the winners of the Written Quiz, Lecture Contest and Regional Physics Essay Competition.

The successful conduct of the events was made possible by the tireless efforts of Prof. Shalini U. V.

and Prof. R. Shivakumar, with the constant support of Principal Prof. P. C. Nagaraja. The enthusiastic young volunteers of Vijaya Pre-University College also played a commendable role in making the programme smooth and memorable.



Senior members of IAPT, Prof. P Nagaraja, Prof. B S Srikanta, Prof. S K Nataraj and Dr. Ananda Kumari R were present throughout the event and supported wholeheartedly.

The event concluded on a highly inspiring note, celebrating the spirit of scientific curiosity, creativity and healthy competition among young physics enthusiasts.

Geetha R. S.

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13th IAPT National Student Symposium on Physics (NSSP) -2026



The IAPT National Student Symposium on Physics (NSSP) is an annual national-level event organized by the Indian Association of Physics Teachers (IAPT) to provide undergraduate, postgraduate and research students a platform to present research, exchange ideas, and engage with experts. Since its inception (2013), this prestigious symposium has been successfully hosted by several leading universities and institutes across the country.

We are glad to announce the 13th IAPT National Student Symposium on Physics (NSSP) -2026 will be held during October 29-31, 2026, at Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore (M.P.)

SALIENT FEATURES OF THE SYMPOSIUM:

1. Invited talks by Subject Experts.
2. Oral / Poster presentations by the UG / PG /Research Students
3. Interactive session for students with scientists.
4. Visit to Research Laboratories.
5. Local hospitality and accommodation for outstation participants.

NSSP-2026 Registration Details:

- **Registration** **Start Date:** 10 August 2026 **End Date:** 20 September 2026
- **Registration fee:** Rs. 1000/- for outstation participants (With Accommodation)
Rs. 700/- for regional participants (without Accommodation)
- **Registration Link:** <https://forms.gle/k7cqCgMG1MT9jqki6>



Abstracts & Manuscripts Submission Details:

- **Submission Window:** 10 August 2026 – 30 September 2026
- **Template Link:**
- <https://drive.google.com/drive/folders/1QwXELxsKjqm7jj6tzBww9-Nn4oL3byzS?usp=sharing>
- **Submission Email:** nssp2026@svvv.edu.in
- **Acceptance Notification:** Status of abstracts/manuscripts will be communicated via email to the corresponding author.
- **Publication Opportunity:** Selected articles will be published in *Student Journal of Physics* (International Edition).



📞 Contact Information:

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Standard Examination in High School Science



Conducted by

INDIAN ASSOCIATION OF PHYSICS TEACHERS

(Regd Office: 206 Adarsh Complex, Awasth Vikas-1, Keshavpuram, Kalyanpur, Kanpur)



Day, Date & Time of Examination

Sunday, November 29, 2026

Time : 10:00 AM to 12:30 PM

Enrolment Opens - 21st September 6:00 AM | Enrolment Closes - 5th October 6:00 PM

Eligibility for Appearing in SEHSS-2026 : Students of class 10 or lower on Nov. 30, 2026
(Especially for those who could not apply for NSEJS-2026)

Language for SEHSS	English, Hindi, Gujarati, Bangala, Kannada or any scheduled Indian language if there are more than 500 students to opt for it.
Examination Fee	Rs. 300.00 (\$20.00 for overseas students)
Format for the Question paper	The question paper shall have 60 questions 48 Objective questions with single correct option and 12 objective questions with any (4,3,2 or 1) correct option of Physics, Chemistry, Biology and Maths with equal weightage to four subjects (12+3 each) at class 10 level

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- ♦ Fully voluntary in a stress free environment
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Photos of students participating in OCSE camp held in April 2026

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- ♦ Every Student on successful completion of the camp will be awarded a **GOLD MEDAL**

Prof B P Tyagi,
Chief Coordinator (Examination)

23 Adarsh Vihar, Raipur Road, Adhoiwala, Dehradun-248001 Ph: 8533993332, 9837123716 email : iaptdn@gmail.com

Prof Vireshkumar H Thakkar,
Coordinator SEHSS (PT Sarvajanic College Surat)

Bridging the gap between curricula and scientific practice - Some thoughts

We are living through a profound transformation of the world—and of science itself. Scientific and technological practices are changing rapidly, propelled by AI, computation, automation and new instrumentation. Yet our classrooms remain several generations behind the laboratories where the future is being created. For too long, education has been **reactive**—the tail that follows changes already made in science and technology. We revise curricula after the world has moved on. In a moment of planetary urgency, this is no longer enough. Science education must become proactive by looking beyond science as a collection of theories and recognizing the deeper interplay between **models, instruments and interventions**. In the chapter below we share some thoughts on addressing these challenges and present suggestions on how to move forward:

Mashood, K. K., Salve, J., Upadhyay, P., Elangaivendan, P., & Chandrasekharan, S. (2026). From conceptual to performative blending: An enactive cognition framework to systematically bridge the gap between curricula and scientific practice. In *Nurturing Minds for Tomorrow: Navigating the Challenges for Attaining Sustainable Development Goals*. Routledge, London. <https://doi.org/10.4324/9781003671176>

Building a **proactive physics curriculum**—one that does not merely respond to changes in scientific practice, but engages students with the processes through which science itself evolves - requires moving beyond science as a finished body of theories and bringing into view the dynamic interplay between **models, instrumentation and interventions**. A theoretical model comes alive when its assumptions and predictions are embodied in physical systems, tested against reality and refined. Instruments, in turn, become technologies that transform the world, generating new phenomena, data and questions that demand new models. Science thus advances through a generative spiral: **theory** → **instrumentation** → **intervention** → **new phenomena** → **new theory**.

The book chapter discusses the history of laser as an illustrative example to elucidate the deep interplay between models, instruments and interventions. Einstein's theoretical prediction of stimulated emission eventually led to the creation of lasers and applications ranging from medicine to LIDAR (used in self-driving cars). Yet lasers did more than translate theory into technology. They opened entirely new experimental possibilities, enabling atomic cooling, optical lattices and the exploration of Bose–Einstein condensates and other quantum phenomena. Instrumentation, therefore, is not merely an application of theory; it can become an engine of new knowledge.

A proactive physics curriculum should bring this generative relationship into the classroom. Rather than simply adding AI and emerging technologies to an already crowded syllabus, we can help students understand how ideas become instruments, how instruments transform the world, and how the transformed world generates new scientific questions. Such a curriculum would prepare learners not simply to keep pace with a changing future, but to develop the imagination, judgement and agency needed to participate in shaping it.

For physics teachers, this shift can begin with small but deliberate changes in classroom practice. Teach concepts through the questions and problems that gave rise to them, rather than presenting them only as finished knowledge. Give students opportunities to move from a theoretical model to a simple physical or computational model, test its predictions, identify its limitations, and redesign it. Use readily available sensors, simulations, microcontrollers, or AI tools to turn abstract ideas into things students can measure, manipulate and interrogate. Ask students not only “What does the model predict?” but also “How could we test it? What would we need to build? What would happen if we changed the assumptions?” Encourage them to examine AI-generated explanations critically, compare them with evidence, and use AI as a partner for questioning rather than an authority for answers. Most importantly, create classroom projects in which modelling, experimentation, instrumentation, computation and real-world problems come together.

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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