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Fig: The Ice Cube Neutrino Observatory

The U.S. National Science Foundation congratulates Francis Halzen on winning the 2026 Nobel Prize in physics for his major contributions to the NSF IceCube Neutrino Observatory and its discoveries of elusive neutrino particles that come to Earth from distant places in the universe. Over more than two decades, NSF invested in the design, construction, and ongoing operations of IceCube, which has enabled greater understanding of astrophysical neutrinos and their origins.

Link: https://www.nsf.gov/mps/updates/2026-nobel-prize-physics-awarded-nsf-icecube-neutrino

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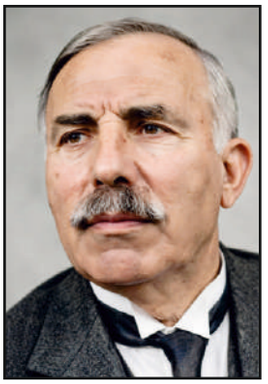
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Editorial

Thinking and Asking Questions: Two Musts for the Learning of Science

Nobel Laureate Lord Rutherford was not only a frontline scientist, he was an outstanding science administrator also. In 1918 at the age of forty-seven he became the Cavendish Professor, a position equivalent to the Director of the famous Cavendish Laboratory at Cambridge University. He used to keep an eye on all the graduate students working there. Among the students he was famous for his loud voice and his Victorian dress that was a bit out of fashion. However, he and most of his students were then doing experimental research work in the areas that bridged the old and the modern physics.



Lord Rutherford

Once Lord Rutherford discovered a student whom he found to be very 'hard working'. He found him working in the lab in the morning or he observed him busy in giving run to his experiments even during the lunchtime. And he noticed him very occupied in the lab with the instruments even when the Professor was walking past the lab well after the dinner. Lord Rutherford became curious about the student and summoned him for a conversation that went on somewhat like this.

Rutherford : Well, I find you have already started working whenever I come early to my office and lab immediately after my breakfast. Isn't it?

Student: Yes Sir! You are right Sir. I do come to the lab early in the morning on all the days. And I start the experiment and go on collecting data.

Rutherford: "'Surely you do. I have seen you occupied with the instruments even at the lunchtime. Don't you break for the lunch"?

Student: "Yes Sir, I do. But I do not waste much time for it. I take the lunch as quickly as possible and get back to my work in the lab. Often the instruments are kept running".

Rutherford: "That's incredible! I believe you wind up your lab activities before the dinner".

Student: "Not fully Sir. I do break for the dinner. But on most of the nights I go back to the lab and start taking data. And sometimes I continue overnight". He then softly mentioned " Because Sir, outside often gets cold at night, when I come out of my lab".

Rutherford was listening to the student patiently. Now he raised his famous voice and enquired, "Well, I do understand your schedule. But can you please tell me one thing"?

The student felt bewildered. His eyes became curious. And Rutherford asked "Well, my dear, when do you think? Yes, but where is your time for thinking"?

We do not know about the reply of the student. But the message of Lord Rutherford was clear and of course loud. A student needs to think. Not only needs to think; but she must think.

And the task of thinking is not at all an easy assignment. A student, not necessarily a research student must be provided with time and the right kind of encouragement to think over the areas she has been exposed to. She must feel the need for this. Often the course contents are so huge that a learner does not get much of a spell to think. And we need to admit that is our country lack of thinking on the part of a student does not necessarily reflect upon the marks awarded in the examinations. So, it is not surprising that the necessity for thinking is not underlined in a big way, neither by the teachers in the educational institutions, nor by the family members at home nor by the well-wishers in the society at large or in the coaching classes.

And this has a domino effect. Once a student does not bother to think about the science she has been exposed to, she does not feel like asking questions.

Unfortunately, we teachers have also been so much deep rooted in the milieu of the entire system we have stopped encouraging our students in asking questions in the classroom. And that brings me to another story as told by Isador Isaac Rabi, the US Physicist who had won the Physics Nobel in 1944. His work in magnetism apart from other things made the MRI (Magnetic Resonance Imaging) a great tool for the medical science today to become a reality.


Isador Isaac Rabi

Rabi's family migrated to US from Europe when he was barely two years old and he grew up in the Jewish community in New York city. The community was very serious about children's education. In the later part of his life Rabi used to declare, "My mother made me a scientist". And then he went on to tell a small story I connection to this. Rabi narrated that all the mothers in the community were serious about their children's study and used to closely monitor the activities of the children. And normally the mothers of his school returned friends asked them "Did you learn anything today"?

This may sound quite normal but Rabi found his mother was asking a different question. She used to ask him affectionately, "Izzy could you ask a good question today"? And in the opinion of Rabi, this provided him with an impetus to look primarily for the questions and not for the answers when he was pursuing the scientific research.

It goes without saying that the precondition for learning not only science but other areas also is to raise questions. And questions cannot be good or bad; they are just questions. But the ability to raise questions demands the habit of thinking on the part of the students. So, these two acts lie at the core of learning science as two great scientists have underlined. And frankly, as teachers we cannot point out the fingers only to our students if they are not following this golden principle. We also need to ponder over the matter and try to see how as teachers we can provide them suitable platforms for the easy flowing thoughts on the areas we teach and the students feel encouraged to raise questions, not necessarily a 'good' question that comes in the mind of the learners.

And after that as teachers we have our responsibility to reply to those questions with care. If we cannot provide the right answer immediately, we can always ask for some time from our students, but the questions must come in from them. Very unfortunately, these two habits are not being encouraged in the classrooms in our country and there are many apparently 'valid' reasons for these to happen. The reasons notwithstanding, we need to encourage the processes of thinking and raising questions by the learners for the betterment of our teaching-learning process, an area specially had been stressed by the founding fathers of the IAPT.

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Physics News

What is a neutrino anyway? A look at the science behind this year's Nobel Prize in Physics

If you wanted a Nobel Prize, you would do well to study neutrinos. To date, the Nobel Prize in Physics has been awarded five times to research related to neutrino detection and discovery. This year, Francis Halzen earned the Nobel "for decisive contributions to the IceCube Neutrino Observatory and the discovery of high-energy neutrinos of astrophysical origin." Neutrinos are elementary particles, meaning they cannot be broken into smaller components, as far as we know. There are three neutrino "flavors": electron, muon and tau. Unlike some other elementary particles, neutrinos have no electric charge. Although they have mass, they are incredibly light—maybe 10 million times lighter than an electron. IceCube is designed to detect ultra-high-energy neutrinos from deep space. These neutrinos are much rarer than the ones that come from the sun. In fact, only a few dozen are detected each year. When a rare neutrino hits the ice, it creates a fast-moving electron or muon. The muon generates a cone of Cerenkov light, allowing scientists to trace the direction the neutrino came from and estimate its energy. It turns out the observatory can also serve to probe the universe's oldest neutrinos and may provide the most data on deep-space neutrinos to date. Fuller says anticipated data from the observatory can help us understand the Big Bang and the early stages of the universe, among other cosmic mysteries.

Read more at: https://phys.org/news/2026-10-neutrino-science-year-nobel-prize.html

Provided By: University of California – San Diego

Against all expectations, researchers control the magnetic core of a single atom

Researchers at Delft University of Technology (the Netherlands) have succeeded in controlling the magnetism in the nucleus of a single atom with radio waves. This came as a surprise: until now, physicists believed that this nuclear spin could not be manipulated directly. The discovery could open up new possibilities for storing and reading quantum information. In their latest experiment, main author Hester Vennema and her colleagues sent two different signals to an atom simultaneously: one targeting the electron and one targeting the nucleus. This allowed them to study the influence of each signal independently. The nuclear spin of atoms is of particular interest for applications in which quantum information needs to be stored securely. The ability to control nuclear spins could provide new opportunities for storing and reading out quantum information. For now, however, the research mainly raises new questions about the mechanism driving the nuclear spin.

Read more at: https://phys.org/news/2026-10-magnetic-core-atom.html

Original Paper: Nature Communications (2026). DOI: 10.1038/s41467-026-78801-5

Can gravitational fields break and reconnect? Einstein's equations suggest they can

More than a century after Einstein first devised the equations that describe gravity, physicists are still finding new ways of interpreting them. Under the right conditions, gravitational field structures can also break and reconnect—a process they call "gravitational reconnection." When they do, energy moves out of the gravitational field and into matter. The findings, published in *Physical Review D*, could help physicists better understand some of the universe's most extreme events, including the collision of black holes. In these environments, gravity is so powerful that space-time becomes highly distorted, making its behavior extraordinarily difficult to calculate. The discovery emerged from an unconventional way of looking at Einstein's equations, building on earlier research into the fundamental rules governing how space-time evolves. For now, gravitational reconnection remains a theoretical discovery.

Read more at: https://phys.org/news/2026-10-gravitational-fields-reconnect-einstein-equations.html

Original Paper: Physical Review D (2026). DOI: 10.1103/lmqy-pf9k

Soumya Sarkar
Duke University, US

November: This Month in the History of Physics

November 1917: Bose Institute founded

Bose Institute or the Basu Vigyan Mandir in Kolkata is the first interdisciplinary research centre in Asia for advanced fundamental research works in physical and biological sciences. It was founded by Sir J C Bose on November 30, 1917. Sir Bose used his entire earnings and generous contributions (valued Rs four lakhs at that time) to establish it. The inaugural session was attended by luminaries - like Sir Nilratan Sircar, Sir P C Roy, Lawrence Dundas (the Governor of Bengal) - from different fields where J C Bose said, 'I dedicate today this institute - not merely a laboratory, but a temple …. The lectures given here will not be mere repetitions …… will announce new discoveries demonstrated for the first time in these halls.' He was not only a physicist and plant physiologist but a true connoisseur of Indian literature, art and philosophy.



The official inaugural song was written and composed by Rabindranath Tagore. Abanindranath and Nandalal Bose created decorative panels and murals for the building. Sir J C Bose served as the founder director of the institute until his death in 1937, followed by the eminent physicist D M Bose. The institute was visited at different times by famous scientists like Niels Bohr, Robert Millikan, Joliot-Curie couple, S Chandrasekhar, et al. J C Bose himself worked here on different fields like electrical responses in plants when subjected to mechanical, electrical and thermal stimuli that are identical to exhibited by animals, plant growth measurement with high magnification crescograph experiment, demonstration of photosynthesis, etc. All these were done with very simple but sensitive equipment, mostly designed by Bose himself. That equipment, along with the millimeter wave transmitter and receiver which he designed while working in Presidency College, Kolkata earlier have been preserved here in the museum at the main campus of the institute. Dr Bibha Chowdhury, in honour of whom the International Astronomical Union named the dwarf star HD 86081 in 2019, once worked in Bose Institute and observed the existence of meson in cosmic rays.

November 1915: General Theory of Relativity

Einstein, after presenting Special Theory of Relativity for inertial frames, planned to extend the relativity theory for all frames. Meanwhile, he was sceptic about the gravity's instantaneous action at a distance without any physical process occurring in between



two bodies. In 1907, while still working in the patent office in Bern, Switzerland, his 'Happiest Thought' of weightlessness of a freely falling body struck to his head. He concluded that gravity on a body is equivalent to it being in an accelerating frame (Principle of Equivalence) and gravity might be included in relativity theory. He wrote to his friend that he guessed the application of relativity theory to explain the gradual shift of the perihelion of Venus. But successive failures to integrate space, time and gravity in a single theory led him to realise that conventional vector algebra and Euclidean geometry were insufficient.

Einstein sought help from his childhood friend Grossmann and learnt Riemann geometry and Christoffel symbols. They jointly submitted some papers. But the covariance of the theory and developing corresponding equations were too difficult. Being frustrated he wrote to his friend Zangger,

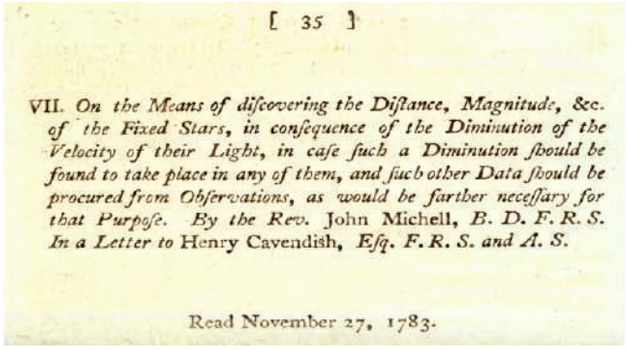
"Nature shows us only the tail of the lion. But there is no doubt…. that the lion belongs with it, even if he cannot reveal himself.....because of his huge dimensions.' After long backbreaking efforts for years Einstein finally was successful and submitted four interrelated papers on four consecutive Thursdays in the month of November, 1915 to the Prussian Academy of Sciences that encompassed space, time and matter in a single tensor equation, called Einstein's Field Equation.

The history of GTR and its connection with the month of November remains incomplete if we don't mention about David Hilbert. The great mathematician, while attempting to unify gravitation and electromagnetic fields, was indeed influenced by Einstein's works in the field of relativity. Regular correspondences among the two were well-known. While Einstein used physical, Hilbert used variational principle of least action as an axiomatic mathematician and derived an identical field equation within a short period of time. He presented his paper 'The Foundations of Physics' five days prior to Einstein's final paper on November 20, 1915 before the Gottingen Academy of Sciences. However, Einstein's GTR paper was published on December 2, 1915 and Hilbert's paper, with some modifications, was published on March 31, 1916.

November 1783: Dark Star

Within a month after Einstein presented his complex tensor equation of GTR, Schwarzschild simplified those with a few assumptions and derived an expression for the radius of the event horizon. If a star is compressed to this radius no light from the star will escape due to space time warping. Later, in 1967, J.A. Wheeler named it Black Hole and its existence was experimentally verified in 1971. One hundred and thirty years before Schwarzschild, the possibility of such a star was mentioned by John Michell, a rector of a Church of Thornhill, Yorkshire. Earlier he was a tutor at Cambridge University and a fellow of the Royal Society of London.

On November 27, 1783 he wrote a seminal letter to Henry Cavendish on subjects spanning pairs of stars (later named binary stars), methods to determine the mass of a star, possibility of dark star, etc. At that time light was believed to be made up of corpuscles, according to Newton, that behaved like inertial particles. Michell argued that as light particles from stars go up against gravitation, their velocity should


[35]

VII. *On the Means of discovering the Distance, Magnitude, &c. of the Fixed Stars, in consequence of the Diminution of the Velocity of their Light, in case such a Diminution should be found to take place in any of them, and such other Data should be procured from Observations, as would be farther necessary for that Purpose. By the Rev.* John Michell, *B. D. F. R. S. In a Letter to* Henry Cavendish, *Esq. F. R. S. and A. S.*

Read November 27, 1783.

decrease. Light from those stars, when passing through a prism on the earth, will be deflected differently from different stars due to different amounts of gravitational pull. Comparative study of the deflections would help one to find the masses of stars.

At the same time, he mentioned, 'If the semi-diameter of a sphere of the same density as the sun in the proportion of five hundred to one, …… all light emitted from such a body would be made to return towards it, by its own gravity'. In the letter he also pointed out that by observing the orbit of its luminous companion the dark star might be detected. This method is even used today. And all these he proposed on the basis of corpuscular theory of light some 200 plus years ago! Though, according to modern knowledge, he was not correct on some aspects, one cannot deny that Michell was the first to presume a non-luminous star. In that sense, he was the first to suggest the possibility of a black hole. Though the letter to Cavendish was published in 1784, the subjects did not draw much attention and were forgotten for about 200 years until Michell's letter to Cavendish was rediscovered in 1979. The great astrophysicist Stephen Hawking also acknowledged the work of John Michell.

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Asit Chakrabarti

Article

Magnetically Modified Coupled Oscillators: A Quintic Nonlinear Model and Maple-Based Exploration of Attractive and Repulsive Interactions

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Abstract: A magnetically interacting oscillator assembly was filmed under four qualitative conditions: weak and strong attraction and weak and strong repulsion. We formulate a phenomenological two-coordinate rotational model whose even coupling potential is expanded to sixth order, yielding linear, cubic and quintic coupling torques. A Maple 2022 computational workflow is proposed for numerical integration, displacement, velocity and acceleration histories, phase portraits, energy evolution, interaction potentials and animated rotor motion. Illustrative numerical samplers demonstrate sensitivity to the local coupling curvature and damping. The model predictions are explicitly separated from measured results: video-based fiducial tracking, geometric calibration and parameter identification remain necessary before quantitative agreement or experimentally observed energy transfer can be claimed.

1. Introduction

Coupled oscillators provide a compact laboratory for normal-mode splitting, transient beating, exchange of energy and nonlinear motion. Magnetic interactions can alter effective stiffness without mechanical contact. In an experiment with two rotating elements, the appropriate measured observables are their angular coordinates and angular velocities; any conversion to arc displacement requires a measured radius. This paper proposes a computationally transparent model and a video-analysis protocol for a magnetic oscillator demonstrator.

Literature context and distinction from earlier studies

Castro-Palacio et al. [1] demonstrated acceleration-sensor measurements of symmetric, antisymmetric and combined normal modes on an air track, with model fits to the measured acceleration. This provides a measurement and uncertainty-analysis precedent, although their coupling was mechanical rather than magnetic.

Donoso, Ladera and Martín [2] investigated magnets oscillating on vertical springs inside two electrically connected coils. Their coupling is induced-current-mediated and proportional to relative velocity in the small-motion approximation, so their model is dissipative/velocity-coupled rather than the conservative relative-angle polynomial used here. Their magnetic mechanism should not be equated with permanent-magnet attraction or repulsion in the present apparatus.

Pathak, Patel and Raj [3] investigated two magnetically interacting swinging pendulums using a smartphone magnetometer, derived approximate normal-mode frequencies and compared them with numerical calculations. Their paper is the closest conceptual precedent for magnetic normal modes and beats. Unlike that pendulum geometry, the present draft adopts two generalized rotor angles, pending confirmation of the experimental kinematics.

The proposed contribution is a comparative, computational exploration of four polarity/strength conditions using a fifth-order relative restoring torque and Maple 2022, with a protocol for extracting two angular trajectories from videos. The cubic and quintic coefficients are not inferred from the three cited papers and must be estimated for this particular apparatus.

2. Apparatus and four experimental conditions

The supplied photograph shows an educational magnetic oscillator assembly with two circular metallic elements arranged vertically. Four recordings are labelled weak attraction, strong attraction, weak repulsion and strong repulsion. The precise pivot configuration, moment of inertia, magnetic pole orientation, separation, fiducial geometry and dimensional scale have not yet been independently established. Consequently, the terms “weak” and “strong” are experimental labels rather than calibrated interaction strengths.



Fig.1 Contrast-and sharpness-adjusted photograph of the supplied laboratory display. The original source should be retained for publication documentation.

3. Two-rotor Lagrangian model

Let $\theta_1(t)$ and $\theta_2(t)$ denote the angular coordinates, $q=\theta_1-\theta_2$ the relative coordinate, J_i the inertias, κ_i the individual small-angle restoring stiffnesses and c_i viscous damping constants. The model potential is

$$U(\theta_1,\theta_2) = \tfrac{1}{2}\kappa_1\theta_1^2 + \tfrac{1}{2}\kappa_2\theta_2^2 + \tfrac{1}{2}K_2q^2 + \tfrac{1}{4}K_4q^4 + \tfrac{1}{6}K_6q^6 \quad (1)$$

The kinetic energy is $T=\tfrac{1}{2}J_1\dot{\theta}_1^2+\tfrac{1}{2}J_2\dot{\theta}_2^2$ and the Rayleigh function is $R=\tfrac{1}{2}c_1\dot{\theta}_1^2+\tfrac{1}{2}c_2\dot{\theta}_2^2$. Lagrange's equations yield

$$J_1\ddot{\theta}_1+c_1\dot{\theta}_1+\kappa_1\theta_1+K_2q+K_4q^3+K_6q^5=0, \quad (2a)$$

$$J_2\ddot{\theta}_2+c_2\dot{\theta}_2+\kappa_2\theta_2-K_2q-K_4q^3-K_6q^5=0. \quad (2b)$$

The quintic torque term arises from the sixth-order even-potential expansion. This is a phenomenological local approximation; actual magnetostatic torque may require a non-polynomial law and may lack $q\mapsto -q$ symmetry for asymmetric geometry. The coefficients are not measured in the supplied recordings.

4. Linear normal modes and stability

For identical rotors $J_1=J_2=J$ and $\kappa_1=\kappa_2=\kappa$, ignoring damping and higher powers, the in-phase and out-of-phase eigenfrequencies satisfy $\omega_{in}^2=\kappa/J$ and $\omega_{out}^2=(\kappa+2K_2)/J$. The origin is linearly stable only when $\kappa>0$ and $\kappa+2K_2>0$. Attractive versus repulsive magnet arrangements do not universally determine the sign of K_2: the sign is set by the local curvature of the interaction energy at the chosen equilibrium.

5. Quintic relative-coordinate reduction

For identical rotors with the centre coordinate $s=(\theta_1+\theta_2)/2$ and relative coordinate $q=\theta_1-\theta_2$, subtraction gives

$$J\ddot{q}+c\dot{q}+(\kappa+2K_2)q+2K_4q^3+2K_6q^5=0. \quad (3)$$

This is a quintic Duffing-type equation. The relative-coordinate effective potential is

$$V_{rel}(q)=\tfrac{1}{2}(\kappa+2K_2)q^2+\tfrac{1}{2}K_4q^4+(\tfrac{1}{3})K_6q^6,$$

with the equation written after dividing by the appropriate effective inertia convention. The physical total energy is best calculated directly from Eq. (1), avoiding ambiguity in relative coordinate normalization.

6. Numerical simulation protocol and Maple 2022

The accompanying Maple 2022 source solves Eqs. (2a,b) using dsolve(...,numeric,method=rkf45), samples angular positions and derivatives, computes accelerations from the differential equations, generates time histories, individual and relative phase portraits, total and local energy traces, coupling potentials, and a two-disc geometric animation. The program runs one condition at a time; the remaining conditions are enabled by uncommenting the corresponding RunCase calls. The animated rotor geometry is schematic, not a photogrammetric reconstruction of the apparatus.

Illustrative dimensionless settings: $J_1=J_2=1$, $\kappa_1=\kappa_2=1$, $c_1=c_2=0.035$, $K_4=0.25$, $K_6=0.12$, $\theta_1(0)=0.65$, $\theta_2(0)=0$, $\dot{\theta}_1(0)=\dot{\theta}_2(0)=0$. Illustrative K_2 values are +0.12, +0.55, −0.12 and −0.35 in the order of the four labels. These values are demonstration choices, not experimental estimates.

7. Experimental video analysis required for quantitative validation

For each recording, rectify the image plane if needed; identify each rotation axis and an off-centre marker; compute $\theta_i(t)$ = unwrap[atan2($y_i-y_c_i$, $x_i-x_c_i$)]; and

calibrate video timestamps. Apply a documented low-pass or Savitzky–Golay smoothing procedure before differentiating to obtain $\dot{\theta}_i(t)$ and $\ddot{\theta}_i(t)$. Plot θ_i versus t, $\dot{\theta}_i$ versus t, $\ddot{\theta}_i$ versus t, $(\theta_i,\dot{\theta}_i)$, $(q,\dot{q})$, and spectra. If the movement is translational, use calibrated $x_i(t)$ instead. Compare the measured curves with model predictions and estimate J_i, κ_i, c_i and K_2, K_4, K_6 using constrained nonlinear least squares with confidence intervals.

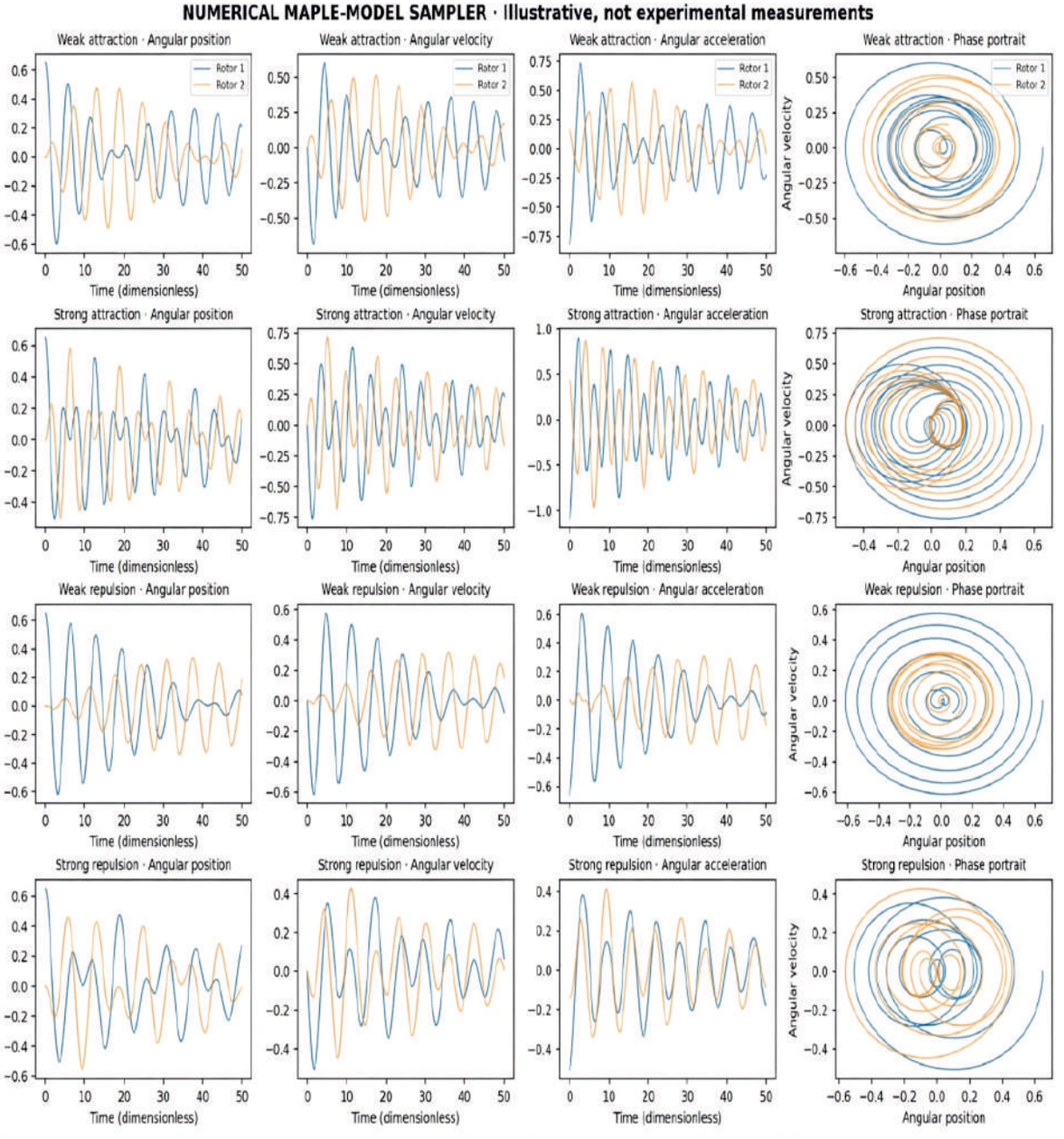


Fig. 2 Numerical sampler of angular displacement, velocity, acceleration and phase portraits for four illustrative parameter sets. Generated independently using numerical integration of the same equations specified for Maple; NOT experimental data.

The sign of the apparent interaction, the size of the angular excursions, and whether both rotors move independently should be confirmed from the apparatus. An actual phase portrait cannot be inferred from a single still frame or from qualitative video labels alone.

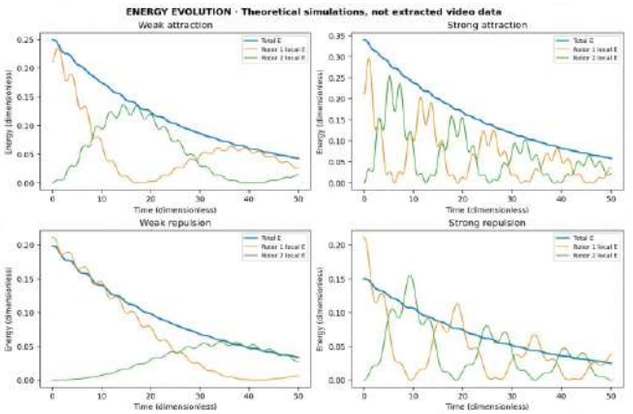


Fig.3 Total mechanical energy and local rotor energies (excluding the coupling energy). Local-energy changes alone do not establish net energy transfer without accounting for the coupling term.

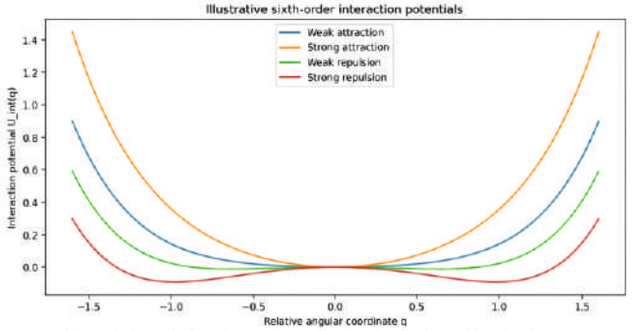


Fig. 4 Model interaction potentials for illustrative coefficients; these are not fitted magnetostatic potentials.

7.1 Measurement, fit and uncertainty recommendations

Measure the rotor centres, rotation axes, angular markers, video frame rate and a physical scale. For each condition and each rotor, obtain angle-versus-time data with propagated marker-position uncertainty; differentiate only after smoothing with a disclosed window length. Estimate dominant spectral peaks and decay rates with uncertainty, then fit J_i, c_i, κ_i and K_2, K_4, K_6 jointly (or use independently measured inertias). Fit quality should be evaluated on held-out segments and against a cubic-only nested model. A nonzero K_6 should not be claimed unless its confidence interval and improved predictive performance justify it. The normalized total energy

$E = \tfrac{1}{2}J_1\dot{\theta}_1^2+\tfrac{1}{2}J_2\dot{\theta}_2^2+\tfrac{1}{2}\kappa_1\theta_1^2+\tfrac{1}{2}\kappa_2\theta_2^2+\tfrac{1}{2}K_2q^2+\tfrac{1}{4}K_4q^4+\tfrac{1}{6}K_6q^6$

obeys $dE/dt = -c_1\dot{\theta}_1^2-c_2\dot{\theta}_2^2$ for the autonomous model. For identical rotors the relative-coordinate equation is $J\ddot{q}+c\dot{q}+(\kappa+2K_2)q+2K_4q^3+2K_6q^5=0$; an effective potential consistent with that equation is $\tfrac{1}{2}(\kappa+2K_2)q^2+\tfrac{1}{2}K_4q^4+(\tfrac{1}{3})K_6q^6$, though this is twice the physical coupling contribution after reducing to the relative coordinate, due to the coordinate normalization.

8. Discussion and Limitations

The simulated phase portraits spiral inward under damping, and the total mechanical energy decreases because $dE/dt = -c_1\dot{\theta}_1^2-c_2\dot{\theta}_2^2 \le 0$ for positive damping. Coupling can redistribute mechanical energy between rotor-associated and interaction terms. When nonlinearities are appreciable, frequency shifts and distorted phase portraits can occur. The present figures establish mathematical plausibility, not agreement with the four videos. In particular, the relative motion may differ materially if the two metallic elements are not independent rotational degrees of freedom.

9. Conclusions

A reproducible computational framework has been established for a magnetically modified coupled oscillator with a quintic interaction term. The Maple program provides an exploratory laboratory for normal modes, nonlinear phase-space motion, energy balance and animation across four illustrative coupling regimes.

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Revisiting Vernier Caliper: Activity Based Learning

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Abstract: It is an attempt to create an activity based learning (ABL) kit for students of class IX and X as per ABL instructional approach led by NEP 2020, fostering deeper understanding of the concept. One such activity "Revisiting Vernier Caliper" is explained here using blocks of different thickness, to learn and understand the working principle of Vernier Calliper. Blocks of known thickness are used to build the main scale and the Vernier scale. Such activity is not found in any of the secondary science textbooks or handbooks for teachers.

Introduction

A Vernier Caliper is a high precision measuring tool used to determine length, outer diameter, inner diameter and depth. It offers greater accuracy than a measuring scale or measuring tape. Typically, the ruler measures minimum 1mm. The Vernier caliper measures 0.1 mm. The Vernier caliper consists of a main scale and a sliding Vernier scale.

Principle of Vernier Calliper

The principle of measurement is based on the difference between a main scale division and Vernier scale division so that precise least count can be obtained.

To understand the working principle of Vernier caliper, some activities are given below.

Activity 1: You are given a pile of 5 blocks, thickness 1unit each plus one block of unknown thickness, (less than1unit.) It is required to find the height of the pile to "nearest possible correct value" [Fig.1(a)]

For that you are provided with some blocks of thickness 1unit and some blocks of thickness 0.9 unit. (blocks are, may be of wood or any other material)

Procedure

i) Take a given pile, (5 blocks of 1unit thickness plus one less thick block) call it pile I. [Fig.1(a)]
Now take another 5 blocks of thickness 1unit and stack them forming another pile, call it pile II. [Fig.1(b)] Put these piles side by side

ii) Put some blocks of thickness 0.9 units over pile I and 1unit thick blocks over pile II so that their heights become almost equal.
Use minimum number of blocks to achieve nearest possible equal heights.

iii) We find 7 blocks of thickness 0.9 units required to put over pile I, Fig.2(a) and 7 blocks 1unit thick, required to put over pile II to make their heights equal. Fig.2(b)
Name these equally heighted piles as pile A and B respective (Fig. 2)

Calculation

Let the thickness (unknown) of block be x.
We have,
Height of pile A = Height of 5 blocks,1 unit thick + x + Height of 7 blocks, 0.9 unit thick.
and
Height of pile B = Height of 5 blocks,1 unit thick + Height of 7 blocks, 1 unit thick.

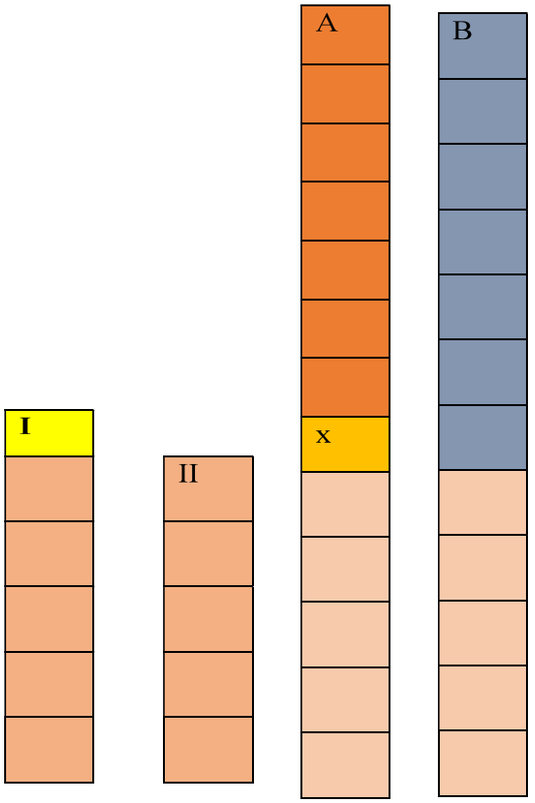
But their heights are equal.

$\therefore (5\times1 + x) + 7\times0.9 = 5\times1 + 7\times1$

$\Rightarrow x = 7\times1 - 7\times0.9 = 7(1 - 0.9) = 0.7$ units

i.e. Thickness of the block is 0.7 units and height of pile is 5.7 units.

In Fig. 2 a/b
5 blocks = 5 units → Main scale reading,
7 blocks= 7^{th} division → Vernier scale reading
1- 0.9 = 0.1 units → Least Count.



Fi .1 a Fi . 1 b Fi .2 a Fi .2 a

Activity 2: Device a method to find the thickness of the given block to nearest possible correct value. For that you are provided with some blocks of thickness 1unit and some of thickness 0.9 units.

Method

Let the thickness of the given block be x**.** (Fig.3)

i) Put some blocks of thickness 0.9 units over the given block making a pile, call it pile C. See Fig. 4(a) ii) Make another pile of blocks, 1 unit thick, call it pile D. Fig. 4(b). Put as many blocks as possible in pile C and D so that piles C and D become almost of equal heights.

Calculations: Let n be the number of blocks required over pile C and m be the number of blocks over pile D, to achieve nearest possible equal heights.

Therefore,

$x + 0.9 \times n = m$

$\Rightarrow x = m - (1-0.1) \times n$

$\Rightarrow x = (m-n) - 0.1 \times n$

It is similar to the formula:

Total thickness = MSD + LC ×VSD

As shown in the figure

$n = 8$ and $m = 10$

$\Rightarrow$ Thickness $x = 2.8$ units

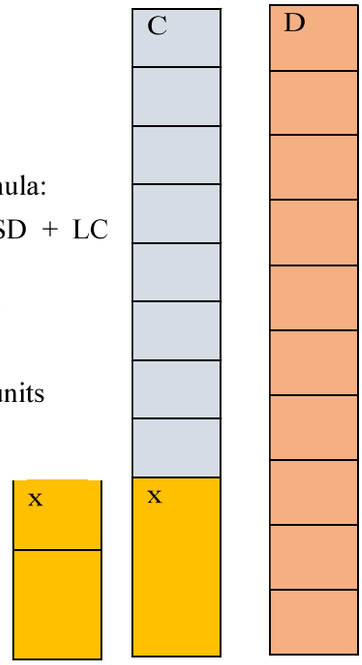


Fig.3 Fig. 4(a) Fig. 4(b)

Activity 3: Using wood or Thermocol sheet, make some blocks of 1unit thickness and ten blocks of 0.9unit thickness (using proper proportion) See how these blocks can be used to measure thickness correctly up to 0.1 units.

Think it over

i) Suppose you are provided with 5 blocks of thickness 4 units and some blocks 5units thick. Can this combination be used to measure lengths? What will be the least count of this combination, Try, making your own blocks and explain the limitations.

ii. Is the combination of blocks of 1 unit and 0.9units thick better for greater accuracy? Discuss.

Analogy with Vernier calliper

Vernier Caliper Concept	**Coin /block Analogy**
1 Main Scale Division (MSD)= 1mm	Thickness of 1 thick block = 1 unit
1 Vernier Scale Division (VSD) =0.9mm	Thickness of 1 thin block = 0.9 unit
10 VSD = 9 MSD	10 thin coins = 9 thick blocks
L.C. = 1MSD – 1VSD	L.C. = Thickness of (1 thick block – 1 thin block)
Total Reading = MSR + (VSR × LC)	Total Reading = Number of thick blocks + (Number of thin blocks) × (difference in their thickness)

Accuracy in measurement of length:

Using two scales of different least count, in combination,

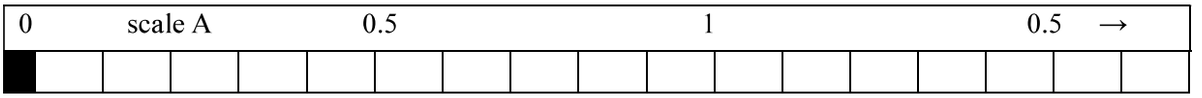




Fig. 5

- It is required to measure length of object PQ.
- See second figure where the object and scale are kept properly to measure the length.
- We see the length is more than 0.6 cm but less than 0.7 cm. (See Fig. 6)
- We may note, length PQ = (0.6 + x) cm or (0.7 – y)

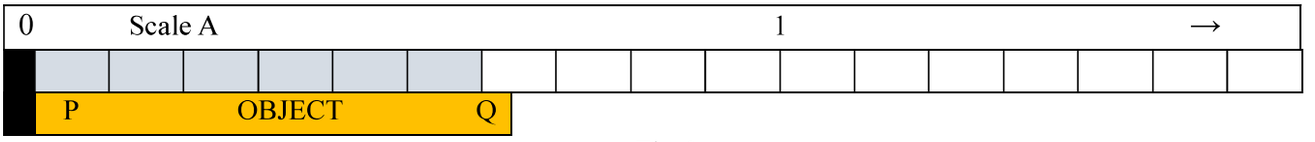
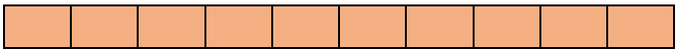


Fig.6

You may ask how to find x or y

- This can be resolved by using another scale with a little smaller or greater least count than that of scale A.
- B is given with least count 0.9 mm. (Smaller than that of scale A)
- One more scale C is given with least count 1.1 mm. (Greater that of scale A)



Scale B

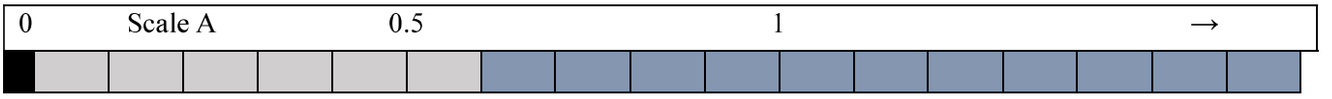


Scale C Fig. 7

In Fig. 6 and 7
Scale A, One division = 1.0 mm
Scale B, One division = 0.9 mm
Scale C, One division = 1.1 mm
10 divisions of scale B = 9
Divisions of scale A and
10 divisions of scale C = 11
Divisions of scale A and

Let us see how the scales can be used.

First, let us use scale B. (brown)





Scale B

Fig. 8

- Put scale B touching the edge of the object with that of scale A, as shown in figure no.8
- Now find which mark of scale A coincides with which mark of scale B.
- We note 10^{th} mark of scale A coincides with 4^{th} mark of scale B.

Note: These 10 divisions (upper) can be considered as 6 +4 ≡ Main scale reading + 4

Now let us find the distance PQ on Scale A and B, in millimeter.

We have, PR =PQ + QR

$6 + 4 = (6 + x) + (4 \times 0.9)$ (Fig. 8)

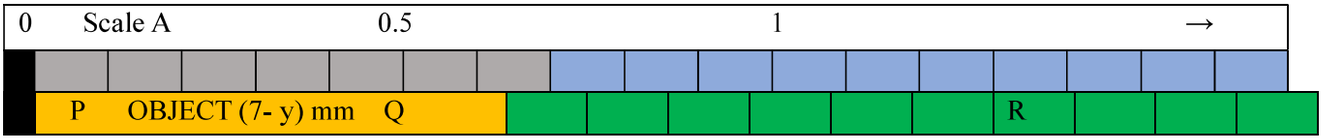
$\Rightarrow x = 0.4$ mm

$\Rightarrow$ Length of object = 0.6 + x = 6.4 mm.

In Fig. No 8
Reading on scale A is 6 mm
4th divisions of both scales A and B coincide each other.

Thus we get more accurate length using combination of scale A and B.

Now let us try using scale C. (green)



Scale C Fig. 9

- Put scale C touching the edge of object with that of scale A, as shown in Fig. 9.
- Now find which division of scale A coincides with which division of scale C.
- We note 13th division of scale A coincides with 6th division of scale C.
  Note: These 13 divisions (upper) can be considered as 7 + 6 ≡ Main scale reading + 6

Now, let us find the distance on PQ on Scale A and C, in millimeter.

We have, PR =PQ + QR

$7 + 6 = (7 - y) + (6 \times 1.1)$ (see the Fig. 9)

$\Rightarrow y = 0.6$ mm

$\Rightarrow$ Length of object = 7 – 0.6 = 6.4 mm.

Thus, we get same result using combination of scales (A, B) and (A, C)

In Fig. 9
Reading on scale A is 7 mm;
6th divisions of both scales A and C coincide each other.

Alternative

Consider reference point R. From this point each main scale division, advances towards left by 0.1 mm than B and lags behind by 0.1 mm for scale C.

Hence, length = 6+ 0.4 = 6.4 mm (scale B)

= 7– 0.6 = 6.4 mm (scale C)

Note: Scale A with bigger least count known as main scale and the scale B with smaller least count known as Vernier scale (named after the inventor: Vernier)

- The difference between their least counts known **as least count of combination of two scales.**
- LC = MSR – VSR and Thickness = MSR + VSR × LC

Operationally, it may be difficult to cut a thermocol sheet into pieces of precisely uniform thickness. Therefore, you may try more suitable options like wood or acrylic sheet or hardboard sheet. I tried some of them. Their photos are given below. Obviously wood is better option.

1. Wooden blocks: Fig. 10



Upper blocks, 1 unit thick and lower blocks are 0.9 unit thick They are numbered.

Here, 7th (upper) and 6th (lower) and are coinciding

$\Rightarrow 7 = x + 0.9 \times 6 \Rightarrow x = 1.6$

Note: MSR = 1

Unknown thickness = 1.6 units.

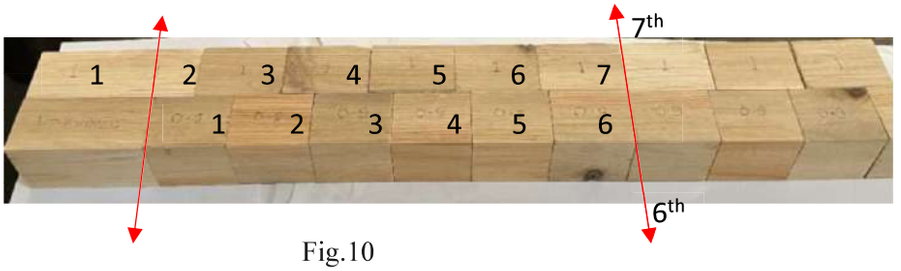


Fig.10

2.Thermocol blocks: Fig. 11

Green blocks, 1 unit thick and red blocks are 0.9 unit.

Note: MSR = 0

6^{th} blocks of both are coinciding $\Rightarrow$ $6 = x + 0.9 \times 6 \Rightarrow x = 0.6$,

Unknown thickness = 0.6 units





Fig No 11

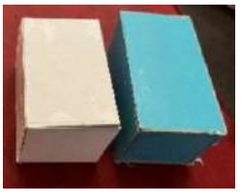
3. Cardboard blocks: Fig.12

Blue blocks, 1 unit thick and white blocks are 0.9 unit thick.

MSR = 0

blocks of both are coinciding $\Rightarrow$ $4 = x + 0.9 \times 4 \Rightarrow x = 0.4$ units

Unknown thickness x = 0.4 units



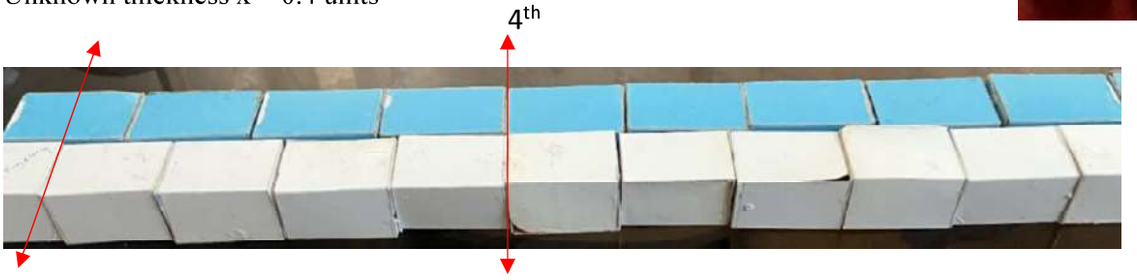


Fig.12

Inference

- If we use two scales A and B of different least count, for finding length, the combination gives more accurate result because the resultant least count of combination is the difference of the least counts of scale A and that of B.
- If x, the unknown thickness is simple multiple of least count of combination then we reach to correct value otherwise the result will be simply "nearest possible correct value"
- (x + total length of Vernier scale divisions) gives the integral value in millimeters.
- Generally, the least count is 0.1 mm. and x is simple (integral) multiple of it. Hence the result obtained are always correct up to first decimal place.

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Article

Numericals First: A Volunteer, AI-Assisted Multimodal Model for Teaching Class 11 Physics on WhatsApp

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Abstract: This paper presents a free, voluntary Class 11 physics programme that I am conducting through a WhatsApp group of more than 160 students and eight to nine Physics teachers. I firmly believe that concepts become clear and students are confident about them only when, they use them in solving numerical problems. The idea is to help them solve numerical problems with a good degree of confidence by strengthening their conceptual understanding through AI-assisted posters, GIFs, animated graphs, home-filmed experiments, voice-over explanations, browser-based HTML lessons, timed quizzes with certificates, higher-order physics challenges, examination-oriented theory PDFs, and cartoon dialogues between Oblelix and Asterix, Young Sheldon and his brother **George Jr**. The paper describes the content system, prompt-refinement process, HTML-app structure, mixed student–teacher community, limitations, ethical concerns, and future research questions. There is no controlled experiment as yet. I propose a plausible practitioner model for using WhatsApp and generative AI without accepting unchecked AI output. The experiment is evolving day by day with newer methods of communication, instructions and assessment.

1. Introduction

Class 11 is when physics changes from a collection of definitions into a quantitative language. Students may recite Newton's second law yet fail to identify the relevant forces or relevant physical quantities in a numerical situation. The difficulty is not simply a lack of material available, but a lack of sufficient emphasis on numericals in which concepts must be identified, applied, rejected, or refined. WhatsApp is already familiar to Indian school students and teachers. This initiative explores whether it can convey more than just announcements or old examination papers through a combination of concept posters, animated graphs, short experiments, screen recordings of worked numericals with voice over, interactive lessons, and timed assessment all free of cost without any complicated login process. To meet this objective, I maintain a free group of about 160+ students and eight to nine Physics teachers. Generative AI supports creation, but the teacher checks every explanation, graph, animation, and numerical for physical accuracy and phone-friendly design. “Theory PDFs” remain available for examinations, while numerical problem solving and challenges are the programme's backbone.

Previous work has examined WhatsApp for extending physics education and discussion [2] Klieger & Goldsmith, Physics Education. 55(2), 025004.https://doi.org/10.1088/1361-6552/ab5d68(2020), social-media-supported learning in the Indian higher-secondary context [3] John & Sreedevi, Voices of Teachers and Teacher Educators. 10(1), 141–145 (2021) and WhatsApp-based AI science assistants [4] Boateng et al. arXiv:2605.15376. https://arxiv.org/abs/2605.15376 (2026). Earlier studies also documented the use of class WhatsApp groups for communication, dialogue and resource sharing [1] Bouhnik & Deshen, Journal of Information Technology Education: Research, 13, 217–231. https://doi.org/10.28945/2051(2014).

The present effort differs by presenting to the mixed volunteer group, a *numericals-first* philosophy, and deliberately a combined bag of posters, GIFs, home video, HTML apps, certificates, and cartoons as one educational strategy.

This model contributes a numerical-first pedagogy in which conceptual understanding is treated as incomplete until students can apply the idea confidently in quantitative problems. It organises learning as a deliberate sequence of representations; Concept posters and GIFs, home experiments and or real-time graphs, short HTML lessons, voice-over

worked solutions, timed single-attempt quizzes with certificates, and higher-order challenges, rather than a collection of isolated resources shared on WhatsApp. The same free group deliberately mixes students with practising teachers, so that misconceptions become visible, expert reasoning is modelled, and continuous teacher oversight of AI-generated material is built into the community itself.

2. Pedagogical stance: Teaching Physics through numerical problems.

The programme is based on the view that a concept is not fully understood until a student can use it to solve a numerical problem and account for the result. Solving the problem requires qualitative decisions like identifying what remains constant, which energy is lost, which force component does work, or whether a bouncing ball ever stops, followed by calculation. The calculation is complete only when the student can also state the physical meaning of the answer, justify why a particular formula applies under the given conditions, and recognise when those conditions fail, which is the essence of conceptual understanding. Numerical success alone is therefore insufficient. Conceptual understanding is demonstrated by the combination of appropriate calculation, qualitative reasoning, and explicit recognition of the limits of the formula used.

It is important to note that this approach does not reject theory. Students need laws, conditions of validity, and derivations for board and competitive examinations, these are supplied in PDFs. I believe while theory is the map, the numerical problems are the territory where it is applied. MCQs, Numericals, and short-answer questions (in the form of model QP if requested) shared are designed so that plausible wrong answers reveal common misconceptions rather than mere play of words. Higher-order challenges add a condition, such as energy loss at impact, a moving wedge, or a non-uniform field that makes the first familiar formula insufficient. The purpose is not to create competitive exam specialists, but to develop the habits of physicists viz identify the situation, choose a principle, calculate, and interpret.

3. The community and the group

The single WhatsApp group is deliberately mixed. Students know that practising teachers are viewing the same material, while teachers can observe misconceptions publicly. Membership is free and carries no fee, or promise of rank, this keeps the emphasis on understanding rather than sales. WhatsApp creates practical design constraints and requirements. Posters must be legible on small screens, GIFs must communicate quickly, PDFs must open easily, HTML apps must work in a mobile browser without installation, and audio or video must remain manageable for students with limited data. Sometimes the author uses the local language (kannada) in videos

Content is sequenced rather than dumped into the group. A typical concept curve is, a poster(s) or GIF, a home experiment or real-time graph, a short HTML lesson, a worked numerical with voice, a set of MCQs and their detailed solution, timed quiz (with a downloadable certificate as an incentive if the score exceeds a threshold), and eventually a suitable challenge and a set of numericals to try. (The solutions for which will be shared after a suitable time before the next lesson/concept starts). Chapter wise PDFs are also shared as exam preparation material (There is a demand for this)

4. The content system

In the following paragraphs I will present the different elements of the multimodal system used. At the end of the article a link is given to view a sample of each mode. The link may be copied and pasted in any Browser like Chrome to view the same

4.1 Concept posters and challenge posters

Posters introduce individual ideas such as instantaneous versus average velocity, negative work, or the slope of a v–t graph. Challenge posters present a numerical situation, diagram, and question that cannot be solved by immediate substitution. ChatGPT and Grok assist with drafting and design, but the teacher rejects output that is decorative, overcrowded, physically incorrect, or unsuitable for Class 11 students. Effective posters use a short title, one focal figure or graph, minimal text, and clear givens, the difficulty lies in the physics, not the language.

4.2 GIFs, animations and graphs

Animations address persistent difficulties. They may

connect motion with its graph, show a graph developing in real time, illustrate the area under a v–t graph as displacement, display changing s–t slope, or show velocity discontinuity during an inelastic impact. They are arguments rather than just ornamentation.

Grok, ChatGPT, and a text-to-animation tool such as Pixarverse are used in production. Prompt refinement (The most crucial part for the teacher) specifies axes, units, time, direction, constants, changing quantities, etc. The teacher checks every output, an animation that cannot be defended at the blackboard is not posted. A visually attractive graph with missing axes, false conservation, or a static image pretending to be real time is rejected.

4.3 Home experiments as prompts, not spectacles

Short, modest experiments may include videos of a ball dropped onto a hard floor, a rotating mop, a homemade pendulum oscillating and the time for n oscillations being asked to be measured using a smart phone's stopwatch and estimate g, the purpose is to attach measurements to familiar events. Students are asked what to measure, what to neglect, and which equation is justified by the conditions. The programme does not assign dangerous experiments involving mains electricity, chemicals, or projectiles. In addition standard experiment is given as an interactive html application (Simple pendulum, Screw gauge, Vernier Callipers, Sonometer to name a few)to enable the students to get a feel of procedure, take reading and also practice calculations before they perform the actual experiment. Check out the google drive link below to perform the simple pendulum experiment (open the application in any Browser like chrome)

4.4 Worked Numericals, voice over screen recordings, and theory PDFs

Solved numericals show the discipline of listing known quantities, naming the principle, writing the equation before substitution, retaining units, and interpreting the answer. The author uses the URAS method. URAS is an acronym for Understand, Recall, Arrange, Substitute & Solve. The method can be viewed in the HTML app in the drive for which the link is given below. Voice-over screen recordings adds the reasoning that a page on the textbook or class notes may omit, why a method was abandoned, how a sign arose, and which error is likely. PDFs of theory support examination preparation but are not intended to replace problem solving.

4.5 Browser-based HTML apps/Quizzes

The most complete lessons are small HTML applications opened in a phone with an internet Browser like Chrome. Usually containing ten or twelve navigable pages, they combine concise text, figures or animations, and, where helpful, recorded voice or short video is also embedded. They keep a lesson as one self-contained unit, requiring no app installation, and allow the teacher to control pace and sequence. The same framework supports timed quizzes. Each student receives a quiz that has one attempt, and a score above a threshold that automatically produces a certificate. The certificate is modest but recognises performance under time and single-attempt conditions, making the exercise closer to examination practice than an endlessly refreshable form.

4.6 Question types and physics challenges

The programme uses familiar multiple-choice, numerical, and short-answer formats. Challenges form its distinctive layer, students wrestle with them rather than passively consume content, and teachers participate as moderators and learners. Productive disagreement is settled by calculation.

4.7 Cartoons: Oblelix asks, Asterix answers George asks and Young Sheldon Answers.

The cartoon series uses Obelix to ask the thoughtful, sometimes sideways question a student may really have, and Asterix to supply the necessary distinction, condition, exception or additional calculation. A second series uses George Jr. to pose everyday confusions and Young Sheldon to resolve them. Both series present physics in a memorable conversational form; they are not a break from the subject. The characters make precision shareable. The cartoons are not a break from physics, they present physics in a memorable and humorous conversational format. Other imaginative characters are used as cartoon to explain and drive home an important idea or concept.

4.8 Guided Experiment

An Html application that prompts the students to take measurements in an experiment, calculate the result, plot graph etc. The idea behind this is that before the student actually performs the experiment in the class he will get an idea of what is to be done, how and what to calculate, plot etc. It is also intended to serve as a quick ready reference before a practical examination

5. Working with generative AI without surrendering the subject

Generative AI speeds up layouts, draft explanations, and motion graphics, but it can invent forces and units or create quantitative-looking graphs with no physical meaning. The project therefore treats AI as a teaching assistant, not as a physics expert. The teacher remains responsible for correctness.

Prompt refinement is part of the teaching workflow. Instead of asking for "a GIF of a bouncing ball," a useful prompt specifies the drop height, fractional energy loss at each impact, plotted quantity, required breaks in the trace, and prohibited decoration. The result is checked against a prior calculation. If the mathematics predicts infinitely many diminishing bounces but finite total distance, the animation must not falsely imply that motion ends after four bounces unless the omission is explained.

The same checking applies to posters and HTML prose. Fluent writing can still confuse mass with weight or change the value of g without explanation. AI is also used to generate near-miss distractors based on real errors, such as omitting one-half, using rebound height instead of drop height, or confusing a weight component with the normal force. Such distractors are retained only after teacher verification.

What is Checked.

Before any AI-generated material is posted, the teacher essentially checks four elements.

a) For equations, the symbolic form, the physical conditions under which it applies, the units, and the algebraic steps are verified against a hand calculation.

b) For graphs and animations, axes, units, direction of motion, conservation (or its deliberate violation), and the time evolution are checked so that the visual does not contradict the physics; an animation that cannot be defended on the blackboard is rejected.

c) For numerical solutions, the principle chosen, the substitution, the units, and the final physical interpretation are examined.

d) Near-miss distractors generated for quizzes are retained only when they reflect known student errors rather than random wording.

This checklist keeps the existing human (Teacher)verification practice reproducible by other teachers. I have even built a dictionary of Physics, Quantum Physics and AI suitable for class XI level.

6. Assessment, feedback, and the certificate

Assessment has three layers: informal chat responses in which students post and discuss working, structured, timed single-attempt HTML quizzes with certificates issued above a threshold, Challenge and practice numericals. These do not replace school examinations, but together create repeated cycles of attempt, feedback, and return.

Conceptual errors likely to help others are corrected publicly, while personal work is corrected privately. Because teachers are present, each public correction also becomes a brief professional-development note for colleagues.

7. What has been observed, and what has not been measured

Students and teachers have generally appreciated the initiative. Group activity shows students opening posters, playing with GIFs, attempting quizzes, valuing certificates, and reusing material in classrooms. These observations indicate engagement and practical usefulness, not measured learning gain. they do not constitute measured evidence of improved conceptual understanding or achievement. No pre- or post-test scores, retention data, or comparison group have been collected. The defensible claim is therefore limited to the feasibility of delivering a dense, numerical-first, multimodal physics programme through a free WhatsApp group under continuous

teacher oversight. Stronger claims about learning gains require systematic data, which is planned for the next phase.

8. Limitations, risks, and ethics

WhatsApp buries older lessons, and new members do not automatically receive earlier material. HTML links help only when retained. Data costs remain, and a timed quiz on a shared family phone may not match the experience of a personal device. Visible group activity can also conceal students who never attempt a numerical.

Students may submit chatbot-generated answers they cannot defend. The response is not an unenforceable ban, but a culture in which an answer must include a principle and working. There is also a risk that the teacher's voice will be replaced by AI. Recorded voice-overs in the author's voice, home videos, and the Oblique–Asterix cartoons help preserve human presence.

Copyright and provenance require continuous attention. Public clips must be properly attributed and used within applicable platform and rules. AI-generated figures must not be presented as experimental photographs. Dangerous experiments are not assigned. Sustainability is another concern: one volunteer is effectively operating a small media unit, and the participating teachers are only the beginning of a succession plan that I have in mind.

All third-party material is either created by the author, generated under the author's direction with generative AI tools, or used under applicable educational fair-use provisions with clear attribution. Public video clips, textbook diagrams or any other external content, when used, are credited at the point of posting (source, creator and date). AI-generated images and animations are never presented as experimental photographs. No copyrighted character likenesses beyond the brief, transformative cartoon dialogues described above are used.

9. A modest agenda for adoption and study

Teachers can begin with one concept poster per week, one motion–graph GIF, one voiceover worked numerical, and one single-attempt HTML quiz. Research should use a concept inventory, implement the multimodal curve, and compare outcomes with a class receiving conventional notes and textbook problems alone with a group that is taught by this method. As of now it is a supplement. Interviews could examine students who attempt challenges but avoid quizzes, or collect certificates without explaining the underlying ideas.

Two especially useful questions are whether pairing filmed motion with a real-time graph improves kinematic-graph understanding, and whether a certificate for a timed single-attempt quiz increases the willingness to attempt a challenge. These are planned in the next phase of this experiment.

10. Conclusion

A free WhatsApp group is an unlikely but practical place to teach physics because it is where students already are. This initiative uses AI as an assistant rather than as a know all and combines several representations deliberately: a poster isolates an idea, a GIF or home film makes it move, a PDF and voice-over show how a number is obtained, an HTML app controls study, a timed quiz tests understanding under constraint, a challenge tests transfer when the first formula fails, and Oblique and Asterix return the idea as dialogue. The model is a practitioner's proposal, not a completed proof of the efficacy of the model. Its central claim is simple if Class 11 students are to learn physics and master the concepts, they must use concepts in calculation confidently and a multimodal approach to explain the concept is effective.

Acknowledgements

The students and teachers in the WhatsApp group have provided the initiative's practical test by staying, arguing, attempting problems, and identifying unclear material. No funding was received or fee charged. The named tools were used as publicly available services, their owners bear no responsibility for the pedagogical choices described here.

Declaration and practical safeguards

The initiative is a free, voluntary educational practice conducted through a single WhatsApp group. Participation requires no fee and no formal enrolment. The group is moderated by the author and a small number of practising physics teachers. Students are

advised not to share personal contact details or photographs of themselves or classmates. When a student's written work is discussed, it is either anonymised or the discussion is moved to a private message. No identifiable student data, screenshots of personal chats, or examination scores have copyright in original content created for the programme.been collected or reported. The manuscript contains only general qualitative observations of group activity.

Materials posted in the group (posters, GIFs, HTML links, voice-overs and PDFs) are intended for the educational use of members. Members are asked not to redistribute the materials outside the group for commercial purposes. The author retain

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About the author.

The author, a life member of IAPT since 1986 and currently the President of IAPT sub RC12A, has four decades of experience in teaching. He is also adopting ICT in classroom at the Higher secondary and UG level. This article is based on an evolving pedagogical attempt he is involved in currently.

Till date 10 chapters have been covered and several multimodal methods have been shared. Any errors in the material that may have crept in is solely due to the author and may be pointed out. A small sample of the material prepared and used by the author can be accessed from the links given below. Copy and paste the link in any Browser like chrome to view the material.

The author urges the reader to check out the material shared. Comments and suggestions for improvement would be welcome. Any class XI student or teacher who desire to join the **Simple-Physics** WhatsApp group may contact me via email at kmrai1204@gmail.com

Mode	Topic	Link
Concept poster	Wave motion	https://tinyurl.com/2enn6zdu
MCQs & Solution	Wave motion	https://tinyurl.com/msau274j
Voice over (Worked Examples)	Wave motion	https://tinyurl.com/3zptctby
Challenge Numerical	Conservation of Mech energy frictional force and work energy theorem	https://tinyurl.com/w557xzd8
Gifs	Projectile motion	https://tinyurl.com/mrxtnffv
Graphs	Projectile Motion	https://tinyurl.com/4b4fk36h
Experiment (HTML)	g by Simple Pendulum	https://g-simple-pendulum.netlify.app/
Home Videos	Bernoulli's principle and Modern Mop	https://tinyurl.com/2fbn2at6
Quiz (HTML)		https://quiz-oscillations.netlify.app/
HTML file	Physics Dictionary	https://dictionary1pu.netlify.app

Report (APhO)

One-Day Workshop

The IAPT–APhO organised a one-day workshop on 9 October 2026 at Shri Vivekanand Vigyan Bharti Inter College, Roorkee, Uttarakhand to familiarise students with the concepts, experimental techniques, and practical applications associated with the Asian Physics Olympiad (APhO). Approximately 80 students from Classes XI and XII participated in the workshop. The sessions focused on developing students' conceptual understanding of physics through experimental learning and introducing them to the principles and techniques involved in APhO-level experiments. Dr. Vijay Kumar, Coordinator, IAPT–APhO, Dr. Monika Mittal, Dr. Neetu Rani, Dr. Arpit Singh, from Dhanauri P G College Haridwar served as resource persons and guided the students through various aspects of experimental physics. Their sessions provided valuable insights into the application of theoretical concepts in practical experiments and encouraged students to develop scientific curiosity, analytical thinking, and problem-solving skills. The workshop was attended by Mr. Raj Kumar Upadhyay, Principal of the school and appreciated the initiative and its contribution to promoting physics education and scientific learning among students. The workshop concluded on a positive note, reinforcing the commitment of the IAPT–APhO Cell to promoting physics education, strengthening experimental skills, and nurturing scientific talent among school students.

Vijay Kumar, Co-ordinator IAPT - APhO





Report (RC-15)

Workshop on
Physics for Future Engineers: From Fundamental to Technology

On an invitation from Narula Institute of Technology, a reputed Engineering College in Kolkata a workshop on “Physics for Future Engineers: From Fundamental to Technology” was jointly organized by RC-15 and the Department of Basic Science & Humanities, Narula Institute of Technology (NIT), West Bengal, on 24 September 2026. at the J. C. Bose Auditorium of the Institute, the programme was attended by nearly 500 first-year engineering students of the Institute.

The workshop was conceived with the objective of highlighting the fundamental role of Physics in the advancement of modern-day S &T. It was planned to underline the role that technology is playing nowadays in various mega science projects and contributing towards the advancement of scientific knowledge horizon. It was particularly aimed at motivating first-year engineering students to develop a deeper appreciation of the basic principles of Physics and the

connection between S&T where engineers are contributing to modern day physics experiments in a great way. The programme began with a brief introduction to the activities and objectives of the IAPT and its Regional Council 15. This was followed by the welcome address delivered by Prof. Subhram Das, Principal, Narula Institute of Technology. Prof. Das welcomed the invited speakers and participants and emphasized the importance of strengthening the scientific foundation of engineering education.

The first technical lecture was delivered by **Prof. Ananda Dasgupta,** IISER Kolkata, on the broad theme of **Quantum Physics and Quantum Cryptography**. The lecture provided the students with an introductory exposure to the principles of quantum mechanics and their application to secure communication. Keeping in view the relevance of the subject to computer engineering and information technology, Prof. Dasgupta explained the basic idea of encoding and transmitting information securely. Through a simple illustrative example, he demonstrated how quantum mechanical principles can be employed for the secure generation and sharing of encryption keys. The lecture offered the students an accessible introduction to the rapidly developing field of quantum information science.

The second technical session was conducted by **Dr. Bhupati Chakrabarti**, formerly of City College, Kolkata, and a former General Secretary of IAPT. He delivered a lecture entitled **"Technological Innovations: Cornerstones for Modern Experimental Physics."** The lecture focused on the close relationship between fundamental Physics, experimental investigations, and technological innovation. Addressing students who are still fresh from their schools; Dr. Chakrabarti emphasized the importance of fundamental physical principles in the development of modern technology. He also underlined how the contribution from the people trained in technology is supporting the experimental Physics to extend its investigations from the realm of investigation of subatomic particles to the detection of signals originating from the cosmos. He highlighted the applications of Physics in materials science, mechanical engineering, GPS technology, and satellite navigation. The session provided the students with a broad perspective on the significant role that engineers can play in making the experimental physics more successful.

The post-lunch technical session commenced with a lecture by **Dr. Swati Das,** Assistant Professor**,** Ananda Mohan College, Kolkata, entitled **"Journey from the Nano World to the Quantum Future."** The lecture introduced the students to the enormous range of length scales encountered in the physical universe, beginning with the dimensions of the universe to the atomic nucleus and extending to the nanoscale and beyond. Through appropriate visual illustrations, Dr. Das discussed the characteristic dimensions and properties of nanostructured materials. She further explained the occurrence of nanoscale structures in nature and outlined their applications in different areas of science and technology. The lecture enabled the students to appreciate the significance of nanoscale phenomena and their potential contribution to future technological developments.

The final session of the workshop was a lecture-cum-demonstration delivered by **Dr. Syed Minhaz Hossain,** Department of Physics, IIEST Shibpur, West Bengal, on **"Physics of Scattering: From Blue Sky to Molecular Fingerprint."** The session effectively combined fundamental theoretical concepts with experimental demonstrations. Dr. Hossain began with a simple demonstration illustrating the relationship between electricity and magnetism. He subsequently discussed the phenomena of Rayleigh scattering and Mie scattering and explained their relevance to several familiar natural phenomena, including the appearance of the blue sky and the formation of rainbows. emphasis was placed on the **primary and secondary rainbows**, as well as the variation in the observed colour of the Sun during sunrise and sunset. Using a laser source, water, and suitable chemicals, Dr. Hossain demonstrated the scattering of light under controlled conditions and explained how the observed colour changes as a consequence of scattering. The experimental demonstrations provided an effective means of connecting theoretical principles with familiar observations from everyday life.

The participation of nearly 500 first-year engineering

students and their active engagement throughout the programme reflected the considerable academic interest generated by the workshop. The programme provided the students with an opportunity to interact with distinguished teachers and to gain an interdisciplinary perspective on the role of Physics in modern technological development.

Lipika Santra & Sukla Chakraborty



Report (RC-15)

Workshop on

Hands-on Experiments

On 16th September 2026, RC-15 organized a workshop on hands-on experiments at Nawabganj Balika Vidyalaya, Ichhapur, West Bengal. The school, a century-old government girls' school, has been honored with the National Paryavaran Mitra Award for its commendable initiatives in environmental sustainability.

The workshop was designed for students of Classes VII, VIII, IX, and X, with 20–30 students from each class participating in the programme. **Prof. Surajit Chakrabarti** and **Prof. Bhupati Chakrabarti**, two senior members of IAPT, took the lead in organizing and conducting the workshop. Twelve senior members of IAPT actively participated in the programme and provided the necessary guidance and support.

The workshop commenced at 11:00 a.m. The experimental activities were organized in four different classrooms and laboratories, with separate sets of experiments arranged for the students of the four classes. The experiments were conducted under the guidance of different IAPT members. Particular emphasis was placed on ensuring that every student had the opportunity to perform the experiments individually. The objective was to encourage students to learn physics through direct observation, measurement, experimentation, and analysis rather than through demonstrations alone.

Experiments for Classes VII and VIII

A number of simple and engaging experiments were conducted for the students of Classes VII and VIII.

1. Relationship between inch and centimeter

The students investigated the relationship between inch and centimeter, as well as between square inch and square centimeter. They measured different lengths using a 30 cm plastic scale and compared the measured values in the two units.

2. Estimation of the area of regular-shaped sheets

The students estimated the areas of regular-shaped two-dimensional sheets by counting the number of small squares under them, after tracing their boundaries on a graph paper. They then compared the experimentally obtained values with those calculated using the corresponding mathematical formulae. The activity was particularly useful in demonstrating the difference between solving a problem theoretically and approaching it experimentally through measurement and observation.

3. Experimental determination of value of π

The value of π was assessed experimentally by determining the lengths of the perimeter of circular discs of different radii. The students carried out the measurements themselves and obtained an approximate value of π from their observations.

4. Determination of the diameter and volume of a metallic sphere

The diameter of a metallic sphere was determined by placing it between two plane hard surfaces and measuring the separation using a ruler. The volume of the sphere was then calculated from its measured diameter.

5. Determination of the density of a solid of regular / irregular shape

A piece of an iron rod of circular cross-section was

taken and its volume was found by measuring its dimensions using a measuring scale. The mass was measured by a digital balance. With those data, density of iron rod was calculated.

The density of irregular pieces of stone, insoluble in water was determined directly by measuring mass with the help of a digital balance and volume by immersing the stones in water kept in a measuring cylinder. A digital balance and a measuring cylinder were used to determine the mass and volume of the samples.

6. Verification of Newton's third law using Archimedes' principle

An experiment was conducted to demonstrate **Newton's third law of motion** through the principle of buoyancy. Using water, a beaker, a digital weighing instrument and a spring balance the students measured the upward buoyant force on a suspended piece of stone immersed fully in water, and the corresponding reaction force and related their observations to Newton's third law.

Experiments for Classes IX and X

For the students of Classes IX and X, experiments covering **magnetism, electronics, and optics** were conducted.

Experiments on Magnetism

1. Determination of the coefficient of static friction of a bar magnet

The coefficient of static friction between a bar magnet and the surface of a working desk was determined by applying different loads and observing the condition for the onset of motion.

2. Measurement of magnetic attractive force

Two similar bar magnets were taken. The second magnet was placed collinearly (in an attractive configuration) with the first magnet, which was attached to one end of a spring balance. The experiment enabled the students to determine the attractive force exerted by the second magnet on the first for a given separation between the two magnets.

3. Study of the repulsive force between two magnets

The repulsive force between two magnets was investigated as a function of the distance between their centers. The force was determined from the additional weight indicated by a digital weighing instrument. This experiment enabled the students to study experimentally the dependence of magnetic force on separation.

Experiments on Electronics

1. Identification of resistors using color codes

The students were introduced to the **color-coding system of resistors** and learned how to determine their resistance values from the color bands. The values obtained from the colour codes were subsequently verified using a digital multimeter.

2. Verification of series and parallel combinations of resistances

The laws governing the **series and parallel combinations of resistors** were verified experimentally using a breadboard, power supply, and carbon resistors. The students assembled the circuits and compared their experimental results with the corresponding theoretical values.

3. Verification of Ohm's law

The students studied **Ohm's law** by measuring the potential difference across a resistor and determining the current through the circuit using the measured resistance and voltage. The experiment helped them to understand the relationship between voltage, current, and resistance through direct measurement.

Experiments on Optics

1. Verification of the laws of reflection and refraction

The laws of **reflection and refraction of light** were verified experimentally using a laser pointer, plane mirror, and protractor. The students measured the relevant angles and compared their observations with the theoretical laws.

2. Study of convex and concave mirrors and lenses

The students studied the behaviors of **convex and concave mirrors and lenses** under different experimental conditions and observed the formation and characteristics of images.

3. Determination of focal length by the u-v method

The focal lengths of a **biconvex lens and a concave mirror** were determined using the **u-v method**, with the torch of a mobile phone used as the light source. The students carried out the measurements and calculated the focal lengths from the experimental data.

4. Study of the passage of light through a prism

The passage of light through a **glass/liquid prism** was studied experimentally. The students drew the corresponding ray diagrams and identified the different angles, including the angle of deviation. The relation $\delta = \mathbf{i_1} + \mathbf{i_2} - \mathbf{A}$ was experimentally verified, where δ is the angle of deviation, i_1 and i_2 are the angles of incidence and emergence, respectively, and A is the vertex angle of the prism.

Conclusion

The workshop continued until **4:30 p.m.** The IAPT members and the science teachers of the school participated in the programme with great enthusiasm and sincerity. The school authorities extended their full cooperation and made all necessary arrangements for the smooth conduct of the workshop.

Lipika Santra & Sukla Chakraborty



Report (RC-16)

One-Day Physics Experimental Camp

A one-day Physics Experimental Camp was organized on 26th September 2026, at Saraswati Shishu Vidya Mandir Mahavidyalaya under the aegis of RC-16. The programme was presided over by Dr. Hrushikesh Acharya, Principal of the College, and brought together educators, resource persons and students in a spirit of scientific inquiry and experiential learning.

Shri Samarendra Bhutia, OAS, Administrative Officer, Odisha Adarsha Vidyalaya Sangathan, Bhubaneswar graced the occasion as the Chief Guest. In his address, he highlighted the contributions of Indian scholars to the evolution of scientific thought and knowledge. Referring to the intellectual heritage of India, he spoke in detail on *Baudhayana's theorem*, *Brahmagupta's identity*, and *the decimal system*, underscoring the enduring significance of these contributions to the development of mathematics and the physical sciences.

Dr. Gourishankar Sahoo, Secretary, RC–16, acquainted the participants with the objectives and activities of IAPT's Learning through Experiments (LePTEx) programme. He emphasised the importance of experimental engagement in transforming the learning of physics from the mere reception of abstract principles into a process of observation, verification and discovery.

A major attraction of the camp was the experimental demonstration conducted by Prof. Abhimanyu Mishra, former Principal of Rajendra College, Bolangir. Beginning with the theoretical foundations of reflection, refraction and dispersion of light, Prof. Mishra demonstrated the associated optical phenomena through a series of simple and illuminating experiments using a periscope, kaleidoscope and optical prism. The demonstrations enabled the participants to observe directly how the laws of physics manifest themselves in the natural world.

Presiding over the programme, Dr. Hrushikesh Acharya emphasised the need to cultivate a genuine scientific temper among students. He observed that science education becomes meaningful when curiosity is awakened, questions are encouraged, and knowledge is tested through observation and experiment.The programme concluded with a vote of thanks proposed by Lecturer of the host institute, Antaryami Nayak.

Gourishankar Sahoo
Secretary

Report (RC-16)

Exploring Neutrino Astronomy: A Public Lecture by a Scientist Associated with the 2026 Nobel Laureate in Physics

Neutrinos: The Cosmic Messengers: On 24 October 2026, RC-16 organised a public lecture on *"Neutrino Astronomy"* at Shri Ramachandra Bhawan, Cuttack. Prof. Sanjeeb Kumar Agarwalla, Professor of Physics, Institute of Physics (IoP), Bhubneswar delivered the keynote address, illuminating the scientific significance of neutrinos and the Ice-Cube Neutrino Observatory in exploring the high-energy universe. The lecture contextualised the Nobel Prize in Physics 2026 and demonstrated how neutrinos, owing to their exceptionally weak interactions with matter, carry valuable information from distant astrophysical sources. Attended by more than a hundred participants, including eminent academics, scientists and literary personalities, the event brought the frontiers of contemporary physics into the public sphere.

Prof. Lambodar Prasad Singh, retired Professor of Physics at Utkal University and a member of the Executive Committee of RC-16, attended as the Chief Guest. In his remarks, he underscored the importance of communicating contemporary scientific discoveries to students, teachers and the wider public. Prof. Rita Paikaray, President of RC-16, delivered the welcome address, while Dr. Gourishankar Sahoo, Secretary of the Regional Council, felicitated the distinguished guests and speakers. The programme was attended by several eminent academics, scientists, educationists and literary personalities, including Prof. Prashanta Kumar Panigrahi, former Director of IISER Kolkata; Prof. Bansidhar Majhi, Vice-Chairman of the Odisha State Higher Education Council; scientist Deb Sahu, Dr. Yudhishthir Sahu, Prof. Kishore Kumar Das, Dr. Bikali Charan Das, Dr. Rajashree Mahapatra, and several other distinguished participants. More than a hundred people attended the lecture, reflecting the keen interest in contemporary scientific developments and the growing public engagement with frontier research. The programme concluded with a vote of thanks by Saubhagya Swain, Vice-President of Kalabila Sanskrutika Parisada, the collaborating NGO and Convener of the program. The event reaffirmed RC-16's commitment to promoting scientific temper, strengthening physics education & bringing significant developments in modern science closer to the public.

The initiative reflects the broader educational philosophy of IAPT RC-16: to unite historical consciousness with scientific rigour, experimental engagement with conceptual understanding, and frontier research with public enlightenment. By reaching students, teachers, scholars and the wider community, the Regional Council reaffirmed its commitment to making physics not merely a subject of academic pursuit, but a shared intellectual adventure.



Program at Banipitha Shriramachandra Bhawan, Odisha

Gourishankar Sahoo
Secretary

Report (RC-16)

National Seminar on

Indian Knowledge System in Physics

(Organised at Government Women's College, Sambalpur)

The inaugural ceremony was held at 11:00am on 21st September 2026. Dr Kalpana Meher, Principal, Government Women's College, Sambalpur, graced the occasion as the Patron and inaugurated the seminar. Presiding over the inaugural session, she spoke of the glorious scientific traditions of India and illuminated the historical contributions of Indian scholars to the advancement of scientific thought. Her address

underscored the enduring light of India's intellectual heritage and the need to revisit its foundational wisdom through the lens of modern scholarship.

Prof. Kishore Chandra Pati, National Institute of Technology (NIT), Rourkela, graced the inaugural ceremony as the Chief Guest. Prof. Rita Paikaray, President, IAPT, RC–16, Prof. Lambodar Prasad Singh, Retd. Professor of Physics, Utkal University, with other noted physicists, graced the occasion.

The Keynote Address was delivered by Dr. Gourishankar Sahoo, Secretary, RC–16. Drawing upon classical astronomical works such as the *Surya Siddhanta, Siddhanta Shiromani* and *Siddhanta Darpana*, he demonstrated the depth, precision and continuity of India's astronomical knowledge. His exposition revealed how the ancient Indian quest to comprehend the heavens was rooted in sustained observation, mathematical reasoning and a profound intellectual engagement with the cosmos.

The seminar further witnessed an illuminating plenary lecture by Prof. Kishore Chandra Pati on "Quantum Computing and Indian Knowledge System (IKS)." He discussed the foundations of quantum computing, including operator formalism, bits and qubits, and explored the conceptual relationship between certain ideas in *Vedantic* philosophy and the development of paradigms associated with quantum mechanics. His lecture opened a stimulating avenue for interdisciplinary reflection between contemporary physics and India's philosophical traditions.

The valedictory programme was graced by Prof. Prasanta Kumar Panigrahi, former Director, Indian Institute of Science Education and Research (IISER), Kolkata, as the Chief Guest. In his plenary lecture, he elucidated the significance of the *Brahmagupta* identity and its potential utility in addressing problems associated with quantum entanglement. His scholarly exposition demonstrated how mathematical ideas developed in the Indian intellectual tradition may offer fertile ground for contemporary scientific inquiry.

A number of distinguished scholars delivered Invited Talks and presented their research during the seminar. Among them were Dr. Gyana Ranjan Sahoo, Assistant Professor, SOA University; Shri Arun Kumar Shasany, Head of the Department of Physics, Bhima Bhoi College; Dr. Akshya Patnaik, Veer Surendra Sai University of Technology, Burla; Dr. Jiten Mishra, Retired Reader in Physics; and Dr. Naubihari Pradhan. Their contributions enriched the academic discourse and provided participants with diverse perspectives on the interface between Indian knowledge traditions and modern physics.

A special feature of the seminar was the Poster Session, in which young participants presented their research and scholarly work. The session provided an encouraging platform for emerging researchers to articulate their ideas, share their findings and engage in academic dialogue with senior scholars. The Best Poster Award was presented during the valedictory session in recognition of outstanding scholarly presentation.

The two-day academic congregation served as a meaningful meeting ground between India's ancient intellectual heritage and contemporary scientific thought. It reaffirmed that knowledge, when pursued with humility and discernment, knows neither the boundaries of time nor the divisions of discipline. The seminar concluded with a renewed call to study the Indian Knowledge System with scholarly rigour, historical sensitivity and scientific objectivity, so that the wisdom inherited from the past may illuminate new pathways of inquiry for the future.

As the ancient spirit of learning reminds us, *"Let noble thoughts come to us from every side."* The seminar thus ended not merely as an academic gathering, but as an invocation to continue the timeless pursuit of truth, knowledge and understanding.



Rita Paikaray
President

One-Day Workshop on the Asian Physics Olympiad (APhO)

The IAPT–APhO Cell, in collaboration with Dhanauri P.G. College, Haridwar, organised a one-day workshop on 28 October 2026 at Yogi Mangal Nath Saraswati Vidya Mandir Inter College, Roorkee, Uttarakhand. The workshop aimed to familiarise school students with the fundamental concepts, experimental techniques, and practical applications of physics relevant to the Asian Physics Olympiad (APhO). Approximately 140 students from Classes XI and XII participated enthusiastically in the workshop. The programme focused on strengthening students' conceptual understanding of physics through hands-on experimental learning and introducing them to the scientific principles, methodologies, and practical skills required for APhO-level experiments. Dr. Vijay Kumar, Coordinator, IAPT–APhO, Dr. Monika Mittal, and Dr. Neetu Rani, from Dhanauri P.G. College, Haridwar, served as resource persons. They guided the participants through various aspects of experimental physics, highlighting the practical application of theoretical concepts. Their sessions encouraged students to develop scientific curiosity, analytical reasoning, critical thinking, and problem-solving abilities. The workshop was attended by Mr. Akash Maheshwari, Principal, Ms. Shivani, and Ms. Lalita Panwar of Yogi Mangal Nath Saraswati Vidya Mandir Inter College, Roorkee. They appreciated the initiative and acknowledged its significant contribution to promoting quality physics education and fostering a scientific temperament among school students. The participating students, teachers, and Principal expressed their appreciation for the workshop and recognised its academic value. They also recommended organising similar programmes in the future to provide students with further exposure to experimental physics and help them prepare for national and international Physics Olympiads. The workshop concluded successfully, reaffirming the commitment of the IAPT–APhO and Dhanauri P.G. College, Haridwar, to advancing physics education, promoting experiential learning, strengthening experimental skills, and nurturing scientific talent among young learners.



Vijay Kumar
Coordinator, IAPT–APhO

Rising Above the Gathering Storm: MIT's Response to a Changing World

This article, briefly reviews the `Report of the Task Force on the Undergraduate Academic Program' from MIT and reflect on some of its key recommendations in the context of rapidly evolving scientific and technological developments. The task force undertook a systematic review of the Institute's undergraduate academic program, with the aim of developing recommendations to sustain and strengthen their preeminence in the years ahead. **https://gue.mit.edu/wp-content/uploads/2026/05/TFUAP-Final-Report-May-2026.pdf**

The report emerged from a rigorous and meticulous process. Since 2024, the Task Force held nearly 100 meetings across MIT, examined more than 70 white papers submitted by the community, consulted dozens of stakeholders individually, reviewed extensive literature and survey findings, and devoted over 150 hours to internal deliberations. The report thus represents a sustained, systematic, and deeply consultative effort, offering a valuable model and reference for other institutions seeking to reimagine and strengthen their programs. The rationale for the review is the recognition by the institute that the world is changing rapidly and the pace of change will continue to accelerate. In a world dominated by disruptive technologies like artificial intelligence, MIT wants to ensure that their undergraduate experience enables deep and meaningful learning among students by combining the best of a residential college experience with the best known practices in education.

A key feature of the proposed new General Institute Requirements (GIR) curriculum is the inclusion of a) computing b) probability, statistics, and machine learning as new subjects. These additions are intended to equip students to navigate an increasingly data-rich world, creatively apply technology to scientific discovery and develop a deeper understanding of the modern AI tools they will increasingly use, develop, and shape. The Humanities, Arts, and Social Sciences (HASS) requirement comprises eight subjects, one of which has to be certified as a Moral and Civic Perspectives subject. This component seeks to cultivate ethical reflection and civic awareness among students by examining how moral principles and notions of responsibility are shaped by, and in turn influence, the societies in which people live. It encourages students to consider the relationship between personal convictions, shared social values, and everyday conduct, equipping them to navigate complex choices and make responsible decisions as members of society.

The committee recommends introduction of a dedicated requirement for developing teamwork skills, recognizing their importance across academic, professional, and personal pursuits. While students often collaborate on assignments and projects as part of their coursework, the proposal emphasizes that working together alone is insufficient; students must also be explicitly taught how to collaborate effectively, communicate across differences, share responsibility, and work collectively towards common goals. The proposal also seeks to foster closer faculty–student relationships by encouraging students to engage with faculty members as mentors within their courses and beyond, creating opportunities for personalized guidance, intellectual exchange, and sustained academic development. Another proposed recommendation is to expand the communication requirement beyond conventional written and oral expression to include visual communication and the ability to convey complex ideas effectively to non-specialist audiences—competencies of growing importance in contemporary society. It also recommends piloting different approaches to integrating generative AI tools into communication courses, generating evidence on how these technologies can best support the development of students' communication skills.

The committee recognizes that high-quality face-to-face learning, a defining element of MIT's residential campus experience, and other innovations depends fundamentally on effective pedagogy. To advance this goal, the committee proposes a five-year, campus-wide initiative to promote the wider adoption of improved pedagogical practices across the Institute, led by their Teaching and Learning Laboratory (TLL).

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