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For the first time, a young, Sun-like star has been caught red-handed blowing bubbles in the galaxy, by astronomers using NASA's Chandra X-ray Observatory.

The bubble – called an "astrosphere" – completely surrounds the juvenile star in this image released on Feb. 23, 2026. Winds from the star's surface are blowing up the bubble and filling it with hot gas as it expands into much cooler galactic gas and dust surrounding the star. The Sun has a similar bubble around it, which scientists call the heliosphere, created by the solar wind. It extends far beyond the planets in our solar system and protects Earth from cosmic radiation.

This is the first image of an astrosphere astronomers have obtained around a star similar to the Sun. It shows slightly extended emission, rather than a single point of light as seen for other such stars.

Link: https: https://www.nasa.gov/image-article/blowing-stellar-bubbles/

Bulletin of The Indian Association of Physics Teachers

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Editorial

Advantages of Artificial Intelligence in Physics Teaching-Learning Process

Due to the advances in current trends in the field of artificial intelligence, built on large language models, based on ideas from statistical physics and neural networks mimicking the human brain, work in this domain has recently been awarded the Nobel Prize in Physics.

Here, I would like to put forth some of the aspects that could benefit physics teachers in building strategies that enhance the learning of physics using AI tools.

First and foremost, it must be stated that, the teacher will always remain at the heart of the teaching-learning process. Technologies such as sensor-based data acquisition, motion and image analysis, computer simulations, learning management systems, as well as AI, are only tools that assist the teacher in enhancing their communication strategies to bring clarity to learners and also remove their misconceptions arising from common-sense thinking.

Modelling and simulation methodologies certainly bring a scientific and logical approach to both thinking and presentation of content. These skills play a major role today in utilizing the power of AI and AI agents in creating content and assessment of different types. Prompt engineering and AI agents are two powerful tools for everyone.

Currently, one can give a simple sentence to an AI agent and start brainstorming with it, refining the prompt until one is satisfied with its clarity. This is achieved when one has strong modelling and simulation skills. If the prompt content is theoretical in nature, one can execute it to create short videos, podcasts, multiple-choice questions, lecture notes or reports, and mind maps, etc.

On the other hand, if the objective is to create a simulation similar to those available on PhET (Physics Education Technology), one can accordingly generate the required specifications, obtain user interfaces with prompts for inputs of various object and interaction variables, and also specify the types of outputs such as graphs, plots, tabulated results, etc. Most importantly, the numerical methods to be implemented in order to solve the underlying physics equations can also be included in the specifications.

Once these specifications are finalized after several iterations of critical review, one can obtain the complete simulation as a ready-to-run application within a few minutes. Alongside, one can also generate user manuals or documentation in both HTML as well as presentation slide formats.

What once required, huge costs towards which Carl Wieman contributed his entire Nobel Prize money, is now available to every teacher at very low cost in terms of both money and time. One can deploy simulations on any topic of interest with ease and enhance the repertoire of their teaching tools.

One thing to keep in mind is the fact that the outcomes obtained by utilising AI for the same prompt by different users will usually result in different results. Needless to say, one has to be careful in ensuring correctness of the obtained simulations and one must also be cautious in regard to ethical considerations. It is said, to prepare for the future, one must challenge the known and embrace the unknown. All of us must strive to embrace this new tool to our advantage by finding the solutions to the challenges that one encounters in the process.

Welcome to the world of AI for creating enhanced teaching-learning paradigms. We look forward to many simulations and innovative teaching content from our esteemed community of the IAPT to be published in our upcoming bulletins. Thank you for this opportunity to contribute my thoughts on this highly debated highly debated topic of AI.

O.S.K.S Sastri
Central University of
Himachal Pradesh

Physics News

Independent measurement strengthens the case for toponium

A new independent measurement by the CMS experiment at the LHC is consistent with the existence of the most massive composite particle ever observed. The first hints of toponium appeared in searches for heavy Higgs-boson-like particles that could decay into a top quark–antiquark pair. An unexpected excess of collision events was observed at a mass close to twice the mass. The new CMS study approaches the problem from a different angle, examining events in which one top quark decays into a bottom quark, a charged lepton and a neutrino while the other decays into quarks that produce sprays, or "jets," of particles as of the top quark, which is more characteristic of a bound state rather than a new fundamental particle. These new techniques proved highly effective. They resulted in the observation of an excess with a statistical significance of more than five standard deviations—the gold standard for a discovery in high-energy physics. Toponium is heavier than the heaviest known atomic nucleus, making it the most massive bound state ever observed

Read more at: https://phys.org/news/2026-03-independent-case-toponium.html

More Information: https://cms-results.web.cern.ch/cms-results/public-results/preliminary-results/TOP-25-002/index.html

Quadratic gravity theory reshapes quantum view of Big Bang

Waterloo scientists have developed a new way to understand how the universe began, and it could change what we know about the Big Bang and the earliest moments of cosmic history. Their work suggests that the universe's rapid early expansion could have arisen naturally from a deeper, more complete theory of quantum gravity. While general relativity has been successful for more than a century, it breaks down at the extreme conditions that existed at the birth of the universe. To address this problem, the team used Quadratic Quantum Gravity, which remains mathematically consistent even at extremely high energies—similar to the kind present during the Big Bang. The research team found that the Big Bang's rapid early expansion can emerge naturally from this simple, consistent theory of quantum gravity. The timing of this work is significant. Cosmology is entering a new era of precision, where new instruments can measure the universe with unprecedented accuracy.

Read more at: https://phys.org/news/2026-03-quadratic-gravity-theory-reshapes-quantum.html

Original Paper: Physical Review Letters (2026). DOI: 10.1103/6gtx-j455

X-ray lasers enable the discovery of a critical point in water

Using X-ray lasers, researchers at Stockholm University have been able to determine the existence of a critical point in supercooled water at around -63 °C and 1,000 atmospheres. Ordinary water at higher temperatures and lower pressures is strongly affected by the presence of this critical point, causing the origin of its strange properties. Water, both omnipresent and essential for life on Earth, behaves very strangely in comparison with other substances. How water's density, specific heat, viscosity and compressibility respond to changes in pressure and temperature is the complete opposite of other liquids that we know. Now researchers at Stockholm University, with the help of ultra-short X-ray pulses from X-ray lasers in South Korea, have succeeded in determining that water has a critical point upon deep supercooling and that critical point is the source of the strange properties. It's amazing how amorphous ice, such an extensively studied state of water, happened to become our entrance to the critical region. It's a great inspiration for further studies and a reminder of the possibilities of making discoveries in much-studied topics such as water

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

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

Soumya Sarkar
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April: This Month in the History of Physics

April, 837 AD: Halley's Comet made its closest approach to the Earth

Halley's Comet, named after the second Astronomer Royal Edmond Halley (1656-1742) who established the periodicity of its appearance, as seen from the Earth as about 76 years on the average. In its highly elliptical orbit around the Sun, two times of approach are relevant – one nearest to the Sun (the perihelion) and the other closest to the Earth. Though its sighting has been recorded for over 2000 years, the first significant appearance occurred in April 837 AD when it came closest to the Earth; 4.8 million km when it appeared as bright as the Venus. For comparison we should keep in mind – the Earth-Sun distance is 149.6 million km. In 1910, it was first photographed and Earth passed through the tail of the comet. One of the substances discovered in the tail by spectroscopic analysis was the toxic gas cyanogen which led to press speculation that life on Earth could be endangered.

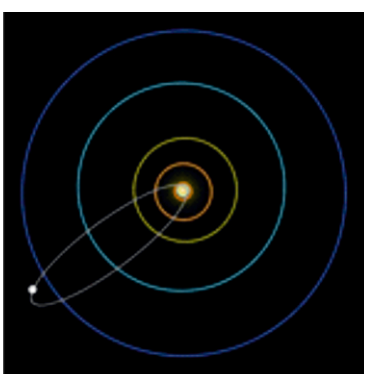

Fig.1 Halley's Comet

An interesting coincidence is worth mentioning: American satirist and writer Mark Twain was born on 30 November 1835, exactly two weeks after the comet's perihelion. In his autobiography, published in 1909, he said, "*I came in with Halley's comet in 1835. It is coming again next year, and I expect to go out with it. It will be the greatest disappointment of my life if I don't go out with Halley's comet. The Almighty has said, no doubt*: *"Now here are these two unaccountable freaks; they came in together, they must go out together."* He passed away on 21 April 1910, the day after the comet's perihelion passage.

The last sighting of the comet was in 1986 when it was visually poor by the naked eye but it was extensively studied by several space probes. The next appearance will be in 2061 when many of us will not be around to observe the spectacle.

April 12, 1852: Birthday of German Mathematician Ferdinand von Lindemann

Ferdinand von Lindemann (1852-1939) is mainly remembered for having proved that the number π is transcendental, that is, it does not satisfy any algebraic equation with rational coefficients. This proof established that the classical Greek construction problem of squaring the circle (constructing a square with an area equal to that of a given circle) by compass and straight edge is insoluble.

In 1873, the year in which Lindemann was awarded his doctorate, famous French mathematician Hermite published his proof that *e* is transcendental. Using similar methods, Lindemann established in 1882 that π was also transcendental. In fact, his proof is based on the proof that *e* is transcendental together with the famous result of Euler that Euler that $e^{i\pi} = -1$. Many historians of science regret that Hermite, despite doing most of the hard work, failed to make the

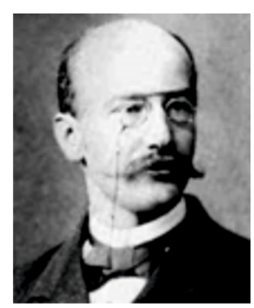

Fig. 2 Ferdinand von Lindemann

final step to prove the result for π. This fame was instead heaped on Lindemann who, by good luck, stumbled on the famous result. Physics was also an area of interest for Lindemann. He worked on the theory of the electron, and came into conflict with Arnold Sommerfeld on this subject. Physicists from various areas have been thoroughly benefitted from his contributions.

April 24, 1990: The Hubble Space Telescope was launched.

After four years of setback with launching vehicle, the Hubble Space Telescope was put into orbit by Space Shuttle Discovery in April 24, 1990. Putting a telescope in space had its obvious advantages of observing very far objects. It was named after famous astronomer Edwin Hubble who established that farther a galaxy is, the faster it moves away from others. As a matter of fact, inverse of the proportionality constant gives an estimate of age of the Universe. The Hubble Telescope was eventually outpaced by the more sophisticated James Webb Space Telescope (JWST) launched in 2021.

Fig.3 Hubble Space Telescope

The history of the Hubble Space Telescope traces to back to 1946, when astronomer Lyman Spitzer's paper "Astronomical advantages of an extraterrestrial observatory" discussed the two main advantages that a space-based observatory would have over ground-based telescopes. First, the angular resolution would be limited only by diffraction, rather than by the turbulence in the atmosphere, which causes stars to twinkle. Second, a space-based telescope could use its "observations" using the infrared and the ultraviolet light, which are strongly absorbed by the atmosphere of the Earth. The telescope was named after the US astronomer Edwin Hubble. The idea of a space telescope began with HST.

April 30, 1897: J.J. Thomson announced the discovery of the electron

Sir Joseph John Thomson (1856 – 1940), a British Physicist, achieved the most brilliant work of his life – an original study of cathode rays culminating in the discovery of the electron, which was announced during his evening lecture to the Royal Institution on Friday, April 30, 1897. He showed that cathode rays were composed of previously unknown negatively charged particles, which he calculated to be bodies much smaller than size of atoms and a very large charge-to-mass ratio. His experiments suggested not only that cathode rays were over 1000 times lighter than the hydrogen atom, but also that their mass was the same in whichever type of atom they came from. He concluded that the rays were composed of very light, negatively charged particles which were a universal building block of atoms. He initially termed the particles "corpuscles", but later scientists christened them as electrons.

Apart from his remarkable research work which won him the Nobel Prize in 1906, Thomson was an influential teacher, and seven of his students went on to win Nobel Prizes, most notable among them being Ernest Rutherford. It is quite remarkable that not only his students but his son, George Paget Thomson, also won the 1937 Nobel Prize for proving the wave-like properties of electrons through diffraction patterns. The paper on the discovery of electrons by Thomson came out in October 1897, but his first announcement about the discovery was made on April 30 1897.

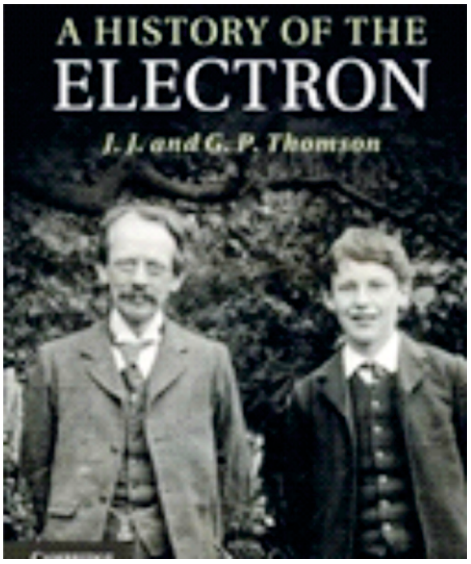

Fig.4 Sir J.J. Thomson and Sir G.P. Thomson

1795 - France adopts the meter as the basic measure of length April 07

In 1790, the French Academy of Sciences was asked to reform the units of measurement. The Academy formed a commission, which rejected using the second's pendulum as a unit of length and decided that the new measure should be equal to one ten-millionth of the distance from the North Pole to the Equator measured through the centre of Paris Observatory.

Fig.5 The distance initially used for defining metre.

However, pending completion of that work, a measurement from Dunkirk on the English Channel to Collioure on the Mediterranean coast (Fig.5) made in 1740 was used, and following legislation on 7 April 1795, provisional metal metre bars were distributed in France in 1795-96.

An early definition of the metre was one ten-millionth of the Earth quadrant, the distance from the North Pole to the Equator. In 1799, the measurement of part of the meridian, from Dunkirk to Barcelona, was completed and a correction for the Earth's non-spherical shape calculated from that and another survey. A metre bar was accordingly made of platinum and designated by law as the primary standard metre. This was kept in the National Archives and known as the *Mètre des Archives*.

Incidentally Napolean Bonaparte (1769-1821), the French Emperor is remembered in history primarily for his military campaigns. However, he had an important role in promoting the science and technology.

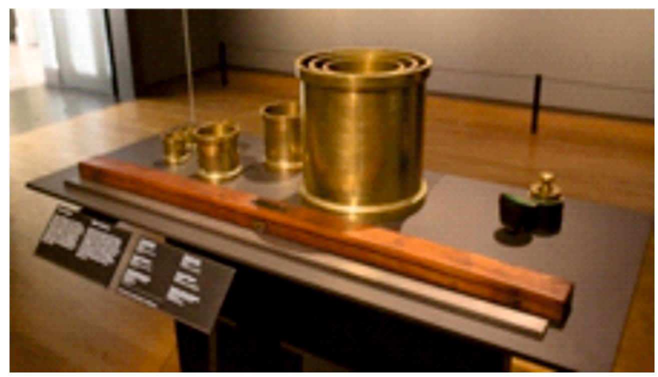

Fig.6 Replicas of historical metric standards, including an iron copy of the *mètre des Archives*.

France has acknowledged this in the caption of the above picture and it says, “In the past, the units of weight and measurement differed from place to place. Napoleon decided to enforce the use of a single system: the metre, the kilogram, and the litre. The precise values were established at a conference held in Paris in 1799”.

Achintya Pal

A Formula for Estimating the Area of a B-H loop

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Abstract: In this paper, we report a novel approach for estimating the area of a B–H loop. A superposition of two hyperbolic tangent functions is employed to mimic the B–H loop with reasonable accuracy. Our earlier attempt in this direction did not yield satisfactory results. In the present work, the B–H loop is well simulated using a pair of analytical expressions after introducing a few modifications to our previous approach.

1. Theoretical background

The B-H loop (B stands for the magnetic field in Tesla and H stands for Ampere-turns/metre), also called a hysteresis loop, is a closed curve which results when B is plotted versus H. The area enclosed by B-H loop represents the energy lost (in Joules) per cycle per cubic metre within a ferromagnetic sample, when an alternating current produces the magnetic field. Hysteresis loss has a big significance in electrical gadgets as the efficiency of transformers, electric motors and various other devices, which use AC power supplies, depend on it.

Historically, the hyperbolic tan function (a plot of the hyperbolic tan function is presented in APPENDIX 1) was first used to simulate the B-H loop by Takacs [1] of Oxford University in the year 2000. He used equations involving hyperbolic tan function to represent the two branches of the B-H loop and started off with an additional term linear in x to account for the reversible part of the magnetisation curve. With the help of a suitable set of parameters (including $x_m \equiv \mathrm{H_{max}/Scale\ factor}$), Takacs [1] could reproduce the major loop with tips at $\pm x_m$; also by introducing another scale factor, (1-Δ)/(1+Δ) he could generate the FORCs (First Order Reversal Curves).

Herceg et al. [2], noticing some deficiencies of the Takacs' model [1], generalized the expression for the magnetic moment of the sample in terms of the applied magnetic field (H) from

$$M = M_S tanh\left(\frac{mH}{kT}\right) = M_S\left(1 - \frac{2}{1+e^{2x}}\right) \quad (1)$$

where m is the dipole moment of an atom, T is the absolute temperature, M_S is the saturation magnetization and $x = \frac{mH}{kT}$, to

$$M = M_S\left(1 - \frac{2}{1+f\ (a,x)}\right) \quad (2)$$

with, $f(a, x) = {}_1F_1(a, 1, 2x)$ a special case of the hypergeometric function ${}_1F_1(a, b, 2x)$. Incidentally the last expression for M reduces to the original one, Eq. (1), when a =1. Armed with this formula and six adjustable parameters, Herceg et al [2] could reproduce almost all hysteresis loops, including minor loops and FORCs. Similar to Herceg et al. [2], we have found that a direct approach involving a trial and error method, applied to a pair of modified fitting functions, gives reasonably good results.

In the present work, we shall first examine whether the B-H loop may be represented by the combination of the curves

$$y = \tanh\,(x+\delta) - \varepsilon \quad (3a),$$

and

$$y = \tanh\,(x-\delta) + \varepsilon \quad (3b)$$

where $x = H/H_0$ and $y = B/B_0$; H_0 and B_0 being two scale factors. B_0 should be equated to B_{max}; H_0 may be set equal to $H_{max}/5$. In the above expressions, δ and ε are two adjustable positive numbers, of which $\delta \sim 1$ and $\varepsilon \sim 0.01$.

The curve represented by the first equation crosses the X-axis at $x \approx -\delta$; to be precise at

$$x = tanh^{-1}\varepsilon - \delta \quad (4a)$$

while the curve given by the second equation has $y = 0$ at

$$x = \delta - tanh^{-1}\varepsilon \quad (4b)$$

These two curves intersect at $x = \pm x_m$ .We shall set x_m as the maximum value of x.

Now

$$\int tanh(x)dx = lncoshx = \ln(\frac{e^x + e^{-x}}{2}) \quad (5)$$

Thus, the area of the loop is given by

$$A = \int_{-x_m}^{x_m} [tanh(x + \delta) - \varepsilon]\, dx - \int_{-x_m}^{x_m} [tanh(x - \delta) + \varepsilon]\, dx$$

$$= 2ln\left[\frac{(e^{x_m+\delta} + e^{-(x_m+\delta)})}{(e^{x_m-\delta} + e^{-(x_m-\delta)})}\right] - 4x_m\varepsilon \quad (6)$$

We may adopt the following strategy to estimate the value of A from experimental data:

From the plot of the loop, find the values of x: $(x_0; -x_0)$, when $y = 0$. Thus

$$\tanh(-x_0 + \delta) - \varepsilon = 0$$

Or, $\delta - tanh^{-1}\varepsilon = x_0$ (7)

Similarly, find the value of y: $(y_0; -y_0)$, when $x = 0$.

$$y_0 = tanh\delta - \varepsilon$$

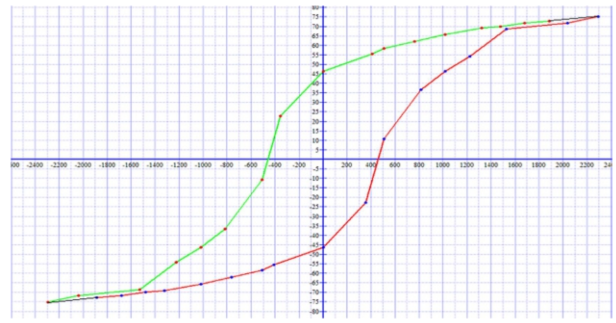
Or,

$$tanh\delta - \varepsilon = y_0 \quad (8)$$

Keeping in mind that ε is a (very) small number, Eqs. (5) and (6) can be solved iteratively to get the values of δ and ε in terms of x_0 and y_0. Using these values, it should be possible to determine the area of the loop [3]. An example of this procedure (for the same data as examined later in this paper in light of the new fitting formulae) is presented in APPENDIX 2.

2. Analysis of recent data obtained from Midnapore college

See the graph shown below:



Each small square measures 100 *Amp.turns/m* × *5 Tesla.*

Number of full squares enclosed within the loop = 196.

Number of incomplete squares enclosed by the loop ≈ 86.

Value of total enclosed area $\approx \left(196 + \frac{86}{2}\right) \times 100 \times 5 \approx$ $119500 A.turns.m^{-1}.Tesla/m^3/cycle$.

This is the hysteresis loss.

The upper curve of the loop crosses the Y-axis (B- value) at 46.35 $Tesla$. We scale it down by a factor of 75 $Tesla$ to get $y_0 = \frac{46.35}{75} = 0.618$.

To get the value of $x\,(\equiv -x_0)$ at which it crosses the X-axis, we use the coordinates of the points on the curve just above and just below the X-axis. Connecting these points by a straight line and locating where the line crosses the X-axis we get the equation

$$0 - (-10.84) = \frac{22.88 - (-10.84)}{-356.5 - (-509.3)} \times [-x_0 - (-509.3)]$$

$\rightarrow x_0 = 460.18$ *Amp.turns/m*,

or, scaling down by a factor of 500 *Amp.turns/m*, $x_0 = 0.9204$.

We now make the following changes:

We examine whether the B-H loop may be represented by the combination of the curves

$y = C\,[\tanh\,(x+\delta) - \varepsilon\ +\ \eta x^2\ ]$

$(C, \delta, \varepsilon, \eta > 0)$ (9)

and

$y = C\,[\tanh\,(x-\delta) + \varepsilon - \eta x^2\ ]$ (10)

Now

$$A = C\left[2ln\left[\frac{(e^{x_m+\delta}+e^{-(x_m+\delta)})}{(e^{x_m-\delta}+e^{-(x_m-\delta)})}\right] - 4x_m\varepsilon + \frac{4}{3}\eta x_m^3\right] \quad (11)$$

The multiplier C and the term $\frac{4}{3}\eta x_m^3$ should account for the value A = 119500 $Joule\ m^{-3} cycle^{-1}$.

Detailed calculations: We have to start from some preliminary or initial guess values of the parameters $C, \delta, \varepsilon, \eta$. The guiding principles are that δ should be close to x_0, C to 1, while ε and η should be in the range 0.001~ 0.01. After several trials we have arrived at the following 'reasonably good fit' values: $\varepsilon = 0.005, \delta = 0.95$, $\eta = 0.002; C = 0.85$

The following table was then generated.

Table 1

x	*x + δ*	*tanh (x+δ)*	*y = tanh (x+δ) – ε + ηx²*
-4.95	-4	-0.9999	-0.9005 – 0.049 = - 0.9495
-3.95	-3	-0.9951	-0.9326 – 0.0312 = - 0.9638
-2.95	-2	-0.9640	-0.9304 – 0.0174 = -0.9478
-1.95	-1	-0.7616	-0.7548 – 0.0076 =-0.7624
-1.45	-0.5	-0.4621	-0.4568 – 0.0042 = -0.461
-0.95	0	0.0	-0.0001 – 0.0018 = -0.0019
-0.45	0.5	0.4621	0.4586 – 0.0004 = 0.4582
0.05	1.0	0.7616	0.7566 – 0.0000 = 0.7566
1.05	2.0	0.9640	0.9622 – 0.0022 = 0.96
2.05	3.0	0.9951	1.0044 – 0.0084 = 0.996
3.05	4.0	0.9939	1.0224 – 0.0186 = 1.0038
4.05	5.0	0.9992	1.0548 – 0.0328 = 1.022
5.05	6.0	0.9999	1.0906 – 0.0510 =1.0396

now multiply x-values by 500, and y –values by C^* =75 × C =75 × 0.85 → y–values obtained above are scaled up by 63.75.

The upper curve is given by:

Table 2A

x × 500	y ×75×0.85
-2475	-60.53
-1975	- 61.45
-1475	- 60.43
-975	- 48.60
-725	- 29.39
-475	-0.1211
-225	29.21
25	48.24
525	61.2
1025	63.5
1525	64.0
2025	65.15
2525	66.27

The corresponding lower curve follows from:

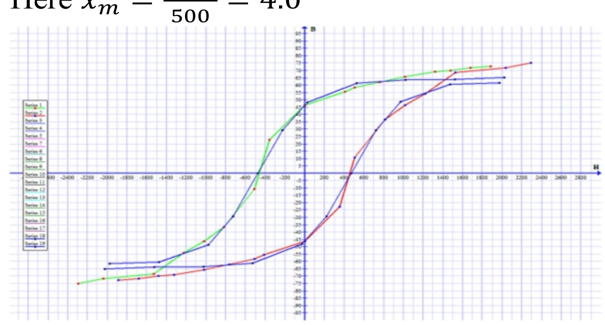
Table 2B

x × 500	*y* ×75×0.85
2475	60.53
1975	61.45
1475	60.43
975	48.60
725	29.39
475	0.1211
225	-29.21
-25	-48.24
-525	-61.2
-1025	-63.5
-1525	-64.0
-2025	-65.15
-2525	-66.27

This gives a reasonable fit to the data.
(Slight lowering of the value of η is likely to give an even better fit.)

Consider the diagram given below:
Green and red curves are obtained on the basis of experimental data. Blue curves are obtained from the assumed formulae. Note that the theoretical values of coercivity (x_0×500) and retentivity (y_0 × 75× 0.85) almost exactly match their experimental counterparts.

Here $x_m = \frac{2000}{500} = 4.0$



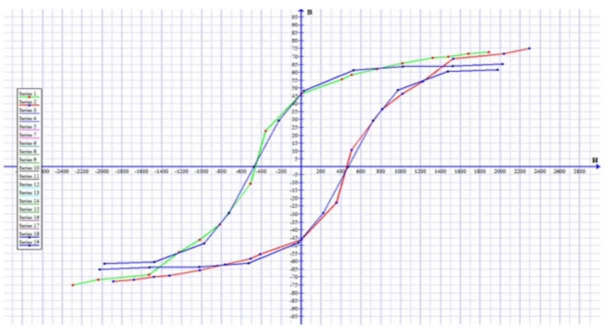
retentivity (y_0 × 75× 0.85) almost exactly match their experimental counterparts.

Here $x_m = \frac{2000}{500} = 4.0$

The value of A:

$$A = C\left[2ln\left[\frac{\left(e^{x_m+\delta}+e^{-(x_m+\delta)}\right)}{\left(e^{x_m-\delta}+e^{-(x_m-\delta)}\right)}\right] - 4x_m\varepsilon + \frac{4}{3}\eta x_m^3\right]$$

Or, $A \approx C\left[4\delta - 4x_m\varepsilon + \frac{4}{3}\eta x_m^3\right]$



In the present case: $A \approx 3.3071$
Scaling back: $A \approx 3.3071 \times 500 \times 75$

$\approx 124015 Joule m^{-3} cycle^{-1}$.

Recall that the experimental value is:

$A \approx 119500(\pm 23\%) Joule\ m^{-3} cycle^{-1}$.

Conclusion

We have now come close to representing B-H loops by a superposition of two relatively simple formulae.

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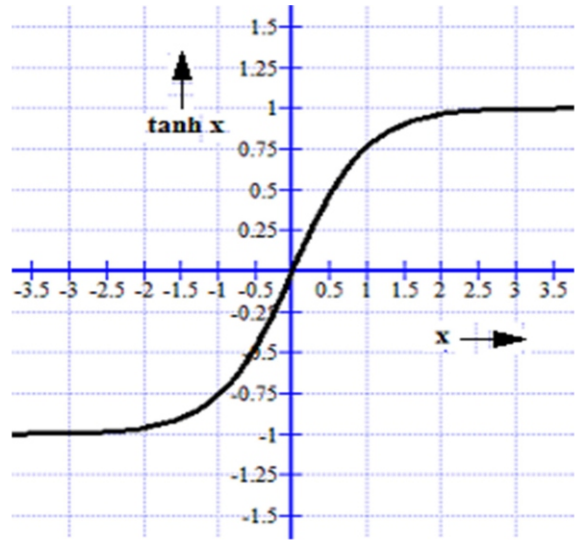
APPENDIX 1



A plot of tanh (x) against x. Note that initially tanh (x) rises almost linearly with x (for x ≥0). Beyond around x = 3 it tends to the asymptotic value 1. Similar characteristics are seen for x≤ 0 with a limiting value of tanh (x) = -1.

APPENDIX 2

(Results obtained in Ref. 1)
Recent data obtained from Midnapore college:

See the graph shown below.

Each small square measures 100 *Amp.turns/m* × *5 Tesla.*

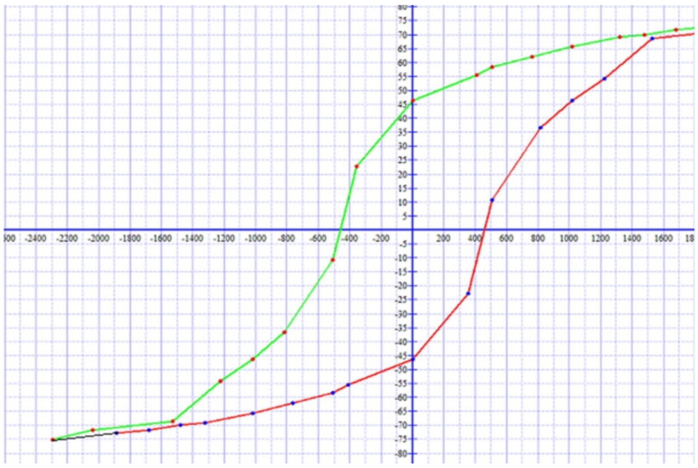
Number of full squares enclosed within the loop = 196

Number of incomplete squares enclosed ≈ 86

Value of total enclosed area $\approx \left(196 + \frac{86}{2}\right) \times 100 \times 5 \approx$
$119500 A.turns.m^{-1}.Tesla/m^3/cycle$

$\approx 119500 Joule/m^3/cycle$

This is the hysteresis loss.



The upper curve of the loop crosses the Y-axis (B- value) at $y_0 = 46.35 Tesla$. We scale it down by a factor of 75 *Tesla* to get $y_0 = \frac{46.35}{75} = 0.618$.

To get the value of $x(\equiv -x_0)$ at which it crosses the X-axis, we use the coordinates of the points on the curve just above and just below the X-axis. Connecting these points by a straight line and locating where the line crosses the X-axis we get the equation

$$0 - (-10.84) = \frac{22.88 - (-10.84)}{-356.5 - (-509.3)} \times \left(-x_0 - (-509.3)\right)$$

Or

$x_0 = 460.18 Amp.turns/m$, or, scaling down by a factor of 500 *Amp.turns/m*, $x_0 = 0.9204$.

Solving for δ and ε:

$$0 = tanh(-x_0 + \delta) - \varepsilon$$

Or

$$\delta = tanh^{-1}\varepsilon + x_0$$

Also

$$y_0 = tanh\delta - \varepsilon$$

First approximation: We assume that $\varepsilon = 0$.
Then, $\delta = x_0 = 0.9204$.
This leads to: $tanh\delta = 0.7261$
Hence
$\varepsilon = tanh\delta - y_0 = 0.7261 - 0.618 = 0.1081$

Second approximation: We use the value of ε obtained above.

Thus, $tanh^{-1}(\varepsilon) = 0.1085$.
Then

$$\delta = tanh^{-1}\varepsilon + x_0 = 0.1085 + 0.9204 = 1.0289$$

This leads to $\varepsilon = tanh\delta - y_0 = 0.7735 - 0.618 = 0.1555$

We may now start calculating the values of $\delta$and ε in the third approximation, beginning with the value of $tanh^{-1}(0.1555) = 0.1563$.

Following this procedure we arrive, after several more rounds, at the 'final' values of ε and δ:

$$\varepsilon = 0.185, \delta = 1.1076$$

Solving for x_m :

We require

$$tanh(x_m + \delta) - tanh(x_m - \delta) = 2\varepsilon$$

Call $x_m + \delta = x_2 \wedge x_m - \delta = x_1$. Thus we require

$$tanh(x_2) - tanh(x_1) = 2\varepsilon$$

Clearly

$$x_2 - x_1 = 2\delta = 2.2152$$

Call $tanh(x_1) = y_1$ and $tanh(x_2) = y_2$. So, $y_2 - y_1 = 2\varepsilon = 0.37$

Consult the graph shown below.

With $x_2 = 3.0$ and $x_1 = 0.78$, the requirements are satisfied. Hence

$$x_m = \frac{x_1 + x_2}{2} = 1.89$$
$$x_m + \delta = x_2 = 3.0$$
$$x_m - \delta = x_1 = 0.78$$

Thus

$$A = 2ln\left[\frac{\left(e^{x_m+\delta} + e^{-(x_m+\delta)}\right)}{\left(e^{x_m-\delta} + e^{-(x_m-\delta)}\right)}\right] - 4x_m\varepsilon$$

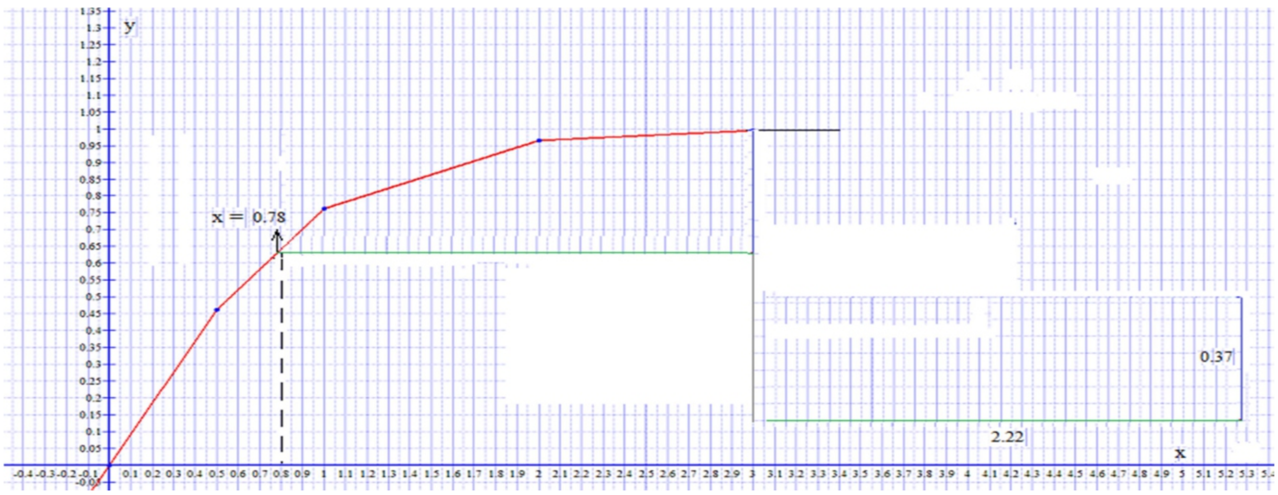
$$2ln\frac{20.086 + 0.0498}{2.18 + 0.4584} - 4.(1.89).(0.185) = 4.065 - 1.397 = 2.668$$

Scaling back

$$A = 2.668 \times 500 \times 75$$
$$= 100050 Joule m^{-3} cycle^{-1}$$

From square counting we obtained

$$A = 119500 Joule m^{-3} cycle^{-1}$$



APPENDIX 3

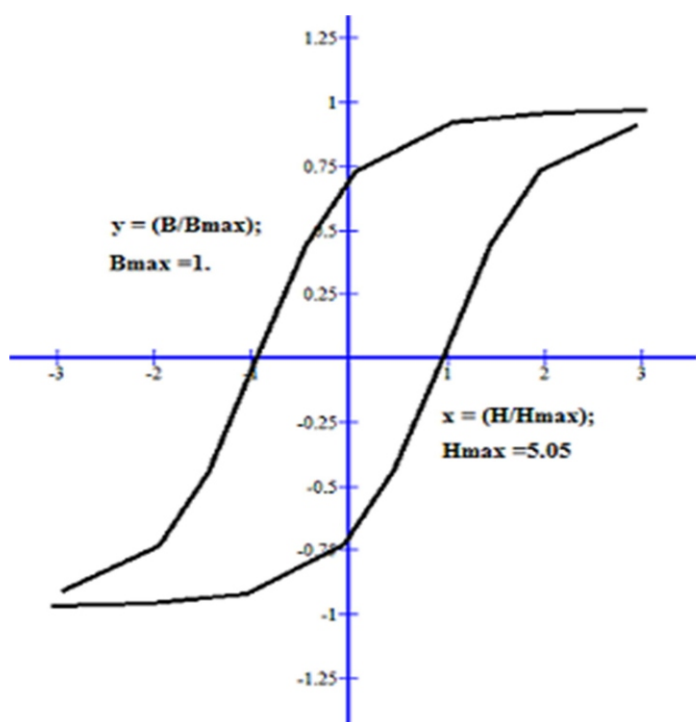
Computed values of H, with H_{max} set equal to 5.05, and B with B_{max} normalized to 1 are given below. The following tables 3A and 3B are based on Tables 2A and 2B:

Table 3A (for the upper branch)

H ($H_{max} \equiv 5.05$)	B ($B_{max} \equiv 1.0$)
- 4.95	-0.913
-3.95	- 0.927
-2.95	- 0.912
- 1.95	- 0.733
-1.45	- 0.443
-0.95	-0.002
-0.45	0.441
0.05	0.728
1.05	0.923
2.05	0.958
3.05	0.966
4.05	0.983
5.05	1.0

Table 3B (for the lower branch)

H ($H_{max} \equiv 5.05$)	B ($B_{max} \equiv 1.0$)
4.95	0.913
3.95	0.927
2.95	0.912
1.95	0.733
1.45	0.443
0.95	0.002
0.45	-0.441
-0.05	-0.728
-1.05	-0.923
-2.05	-0.958
-3.05	-0.966
-4.05	-0.983
-5.05	-1.0



Plot of the data presented in Tables 3A and

Quantum Computing and the Future of Cryptographic Security: Shor's Algorithm, Present Realities, and Post-Quantum Defences

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Abstract: The security of widely used public-key cryptographic systems such as RSA rests on the computational difficulty of factoring large integers. Shor's quantum algorithm, proposed in 1994, can solve this problem in polynomial time and therefore poses a fundamental long-term challenge to modern digital security. This article provides an accessible overview of how Shor's algorithm works, assesses the practical limitations of its execution on current quantum hardware, and introduces the lattice-based cryptographic schemes CRYSTALS-Kyber and CRYSTALS-Dilithium, which have been standardized by NIST as quantum-resistant alternatives.

1. The Cryptographic Foundations Under Threat

Every time a password is sent over the internet or a financial transaction is authenticated, the data is almost certainly protected by RSA encryption or Elliptic Curve Cryptography (ECC). These systems are built on problems that are easy to construct but extraordinarily hard to reverse using known classical methods. RSA, for example, depends on the difficulty of factoring the product of two large prime numbers. A 2048-bit RSA key involves a number with over 600 decimal digits; the world's fastest classical supercomputers would take longer than the age of the universe to factor it by brute force.

Peter Shor's 1994 discovery changed this picture fundamentally. He showed that a sufficiently powerful quantum computer could factor large integers in polynomial time, an exponential speedup over the best classical algorithms. At the heart of his approach is the Quantum Fourier Transform (QFT), which enables the computer to detect hidden

periodicity in modular exponentiation sequences. Once that periodicity is found, the prime factors follow directly.

2. How Shor's Algorithm Works: A Conceptual Overview

The algorithm unfolds in three stages.

- The first is entirely **classical:** choose a random integer *a* with $1 < a < N$, where N is the number to be factored, and verify that $gcd(a, N) = 1$.
- The second stage is **quantum:** use Quantum Phase Estimation (QPE) to find the *period* r of the function

$f(x) = a^x \bmod N$

that is, the smallest positive integer r such that $a^r \equiv 1$ ($mod\ N$). This periodic structure is inaccessible to classical computers without exponential effort, but the QFT makes it computable in polynomial time on a quantum processor.

- The third stage is classical again. Once r is known, compute gcd and $(a^{r/2} - 1, N)$ gcd $(a^{r/2} + 1, N)$

With high probability these yield the prime factors of N, provided r is even and $a^{r/2} \equiv 1$, N (mod N). If the conditions are not met, a new base *a* is chosen and the process repeats. The elegance of the approach lies in delegating only the computationally hard part, period-finding, to the quantum device, while the surrounding bookkeeping runs efficiently on a classical computer.

3. The Gap Between Theory and Today's Hardware

Despite its theoretical power, running Shor's algorithm on real quantum hardware is a different matter entirely. We are currently in the Noisy Intermediate-Scale Quantum(NISQ) era, where available machines have hundreds to thousands of qubits but suffer from short coherence times, significant gate error rates, and limited qubit connectivity. A recent experimental study by Bagourd and colleagues (2026) put this concretely to the test, running Shor's algorithm on

IBM's cloud-accessible 133-qubit superconducting processor *ibm_ torino.*

The team attempted to factor three numbers: 15, 21, and 35. For N = 15 and N = 21, the algorithm produced statistically significant quantum signals above the noise baseline, confirming genuine quantum computation was taking place. For N = 35, results were inconsistent and heavily dependent on the choice of algorithm parameters, suggesting the device was operating near its practical limit. It is worth pausing on what this means: 35 is a six-bit number. RSA keys in everyday use are 2048 bits.

The statistical test used was a one-sided binomial test on the hit-rate $\hat{p}$ within Quantum Phase Estimation acceptance windows. For $N = 15$ the test returned a p-value of 3.50×10^{-27}, strongly rejecting the null hypothesis of a uniform (noise-dominated) output distribution N = 35 with an unfriendly base, the p-value rose to 1.17×10^{-2}, failing the $\alpha = 0.01$ significance threshold entirely.

Two further challenges stood out. First, each circuit had to be individually designed for a specific modulus N. There is no general-purpose, hardware-agnostic implementation of Shor's algorithm available today. Attempts to run circuits on trapped-ion and neutral-atom platforms via Amazon Braket and Microsoft Azure Quantum both failed at the transpilation stage. Second, the machine's calibration fluctuated noticeably from day to day. Readout error rates ranged from 0.58% to 7.83% across different calibration cycles, and some experimental runs had to be discarded as effectively unusable.

Resource estimates for attacking real cryptographic keys are sobering. Earlier analyses suggested that factoring a 2048-bit RSA modulus would require on the order of 20 million physical qubits running for roughly eight hours, assuming high-quality error correction [4]. More recent algorithmic improvements have reduced this estimate significantly, with one analysis bringing the physical qubit count below one million [5], and another proposing that around 13,436 logical qubits in a specialized architecture with multimode quantum memory could in principle suffice [6]. These are genuine advances, but they remain far beyond what any existing system can deliver. The broad research consensus is that a practical quantum attack on deployed cryptography is not a near-term threat. It is, however, a credible long-term one, and that is precisely why the response has already begun.

4. Post-Quantum Cryptography: CRYSTALS-Kyber and CRYSTALS-Dilithium

Migrating global cryptographic infrastructure takes decades. Recognizing that preparation must begin long before a quantum threat becomes operational, the US National Institute of Standards and Technology (NIST) ran a multi-year open competition to identify and standardize quantum-resistant algorithms. In 2024, the process produced its first formal standards, and two of the most significant are CRYSTALS-Kyber and CRYSTALS-Dilithium, now officially designated ML-KEM and ML-DSA respectively.

Both algorithms belong to the family of lattice-based cryptography. A lattice is a regular, discrete arrangement of points in high-dimensional space, formally defined as the set of all integer linear combinations of a fixed basis $\{\mathbf{b}_1, \mathbf{b}_2, \ldots, \mathbf{b}_k\} \subset \mathbb{R}$ Certain computational problems on these structures appear to be hard even for quantum computers. Specifically, Kyber and Dilithium are built on the Module Learning With Errors (MLWE) problem. Given a matrix $\mathbf{A}$ sampled uniformly over a ring, a secret vector $\mathbf{s}$, and a small noise vector $\mathbf{e}$, the problem is to recover $\mathbf{s}$ from the pair ($\mathbf{A}$, $\mathbf{As} + \mathbf{e}$). No polynomial-time quantum algorithm for this problem is currently known.

CRYSTALS-Kyber serves as a Key Encapsulation Mechanism (KEM), providing the quantum- safe equivalent of the key exchange protocols that underlie secure web connections today. CRYSTALS-Dilithium is a digital signature scheme, used to verify the authenticity of messages, software updates, and documents. Both are designed to be computationally efficient, with key and signature sizes only modestly larger than their classical counterparts, making them practical to deploy across the systems that currently rely on RSA and ECC.

The name CRYSTALS stands for Cryptographic Suite for Algebraic Lattices. Their selection by NIST, following years of cryptanalytic scrutiny from the global research community, gives reasonable confidence in their security. That said, lattice-based cryptography is a younger field than RSA, and ongoing research continues to sharpen our understanding of exactly how hard the underlying problems are. Vigilance and periodic reassessment remain important.

5. Outlook

The trajectory of quantum computing research is genuinely impressive. Qubit counts are rising, error rates are falling, and algorithmic improvements continue to reduce the resources needed to run Shor's algorithm at scale. Industrial roadmaps from IBM, Google, IonQ, and Quantinuum point toward fault-tolerant quantum computers within the next decade or two, though the engineering challenges involved should not be underestimated. What current experiments tell us is that the gap between a 133-qubit NISQ device struggling with N = 35 and a machine capable of breaking 2048-bit RSA is enormous, spanning many orders of magnitude in both qubit quality and count.

The post-quantum transition is already underway. Governments, financial institutions, and technology companies are beginning to deploy or test quantum-resistant algorithms. This is sensible not only because quantum computers are improving, but because of the "harvest now, decrypt later" threat: adversaries may already be collecting encrypted data today, intending to decrypt it once a capable quantum machine exists. For sensitive information with a long secrecy lifetime, the threat is effectively present tense.

Shor's algorithm sits at the intersection of quantum physics, number theory, and computer science. Its story illustrates how a purely theoretical result, published three decades ago, can reshape the practical priorities of an entire field of engineering. The lattice-based schemes now being standardized draw equally on deep mathematics. Together, they represent one of the more fascinating episodes in the ongoing conversation between fundamental science and the world it shapes.

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Article

National Quantum Mission*

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(***Compiled by the author in view of IYQ–2025, from the information available in public domain**)

Abstract: The National Quantum Mission (NQM) of India represents a strategic leap toward establishing the country as a global leader in the field of Quantum Science and Technology. It was launched in 2023. The mission aims at developing scalable quantum technologies, including quantum computing, secure quantum cryptography, quantum sensing and precision timing. With a proposed investment of ₹6,000 crore over eight years (2023–2031), the NQM seeks to build a robust quantum ecosystem of India by fostering interdisciplinary research, developing indigenous hardware and software and nurturing a skilled quantum workforce. This article explores the objectives, mission focus, mission implementation strategy, challenges ahead, thrust areas and global significance of the NQM, while also addressing the challenges and opportunities it presents for India's scientific, economic, and strategic future.

National Quantum Mission

The Union Cabinet, under the leadership of the Prime Minister Shri Narendra Modi, approved the National Quantum Mission (NQM) on 19th April 2023 with some specific aims. The responsibility of its implementation lies with the Department of Science & Technology (DST) under the Ministry of Science & Technology.

As the mission is launched, India becomes the seventh country in the world to have a dedicated Quantum Mission. The other countries are USA, Austria, Finland, France, Canada and China.

The total budget of the NQM amounts to Rs.6003.65 crore for the period 2023-24 to 2030-31, i.e., during a span of eight years. Broadly speaking, the implementation of NQM has three timelines, namely, 3 years, 5 years and 8 years.

Objectives of the Mission

- The NQM seeks to initiate, support and expand research and development in science and industry, while fostering a dynamic and innovative environment in the field of Quantum Technology (QT).
- It will help to accelerate QT-led economic growth, foster the ecosystem towards QT in our country.
- It focusses on making India one of the leading nations of the world in the field of development of Quantum Technologies & Applications (QTA).
- This involves building medium-scale quantum computers containing 50 to 1000 physical qubits over a period of eight years, utilizing various technologies like superconducting systems and photonic platforms. (Similar to how classical computers use bits, 0s and 1s, as the fundamental units of information, quantum computers use 'qubits' or quantum bits to perform their computations.).
- It aims at establishing secure quantum communication via satellite between ground stations across a distance of 2000 km within India. At the same time, it seeks to enable long-range secure quantum links with foreign nations.
- Finally, it expects to have inter-city quantum key distribution over a range of 2000 km.

Mission focus:

- The NQM is dedicated to advancing ultra-sensitive magnetometers using atomic systems, along with atomic clocks for accurate timing, communication, and navigation.
- It will also aid in the development and creation of quantum materials like superconductors, advanced semiconductor structures and topological materials for building quantum devices.
- Single photon sources/detectors and entangled photon sources will also be developed for quantum communications, sensing and

metrological applications.

Mission Implementation:

- In a major step towards the NQM, four Thematic Hubs (also called T-Hubs) are established in selected premier Academic and National R & D institutes in the areas listed :

1. Quantum Computing
2. Quantum Communication
3. Quantum Sensing & Metrology
4. Quantum Materials & Devices

- The selected institutions are, (i) IISc, Bengaluru; (ii) IIT, Madras along with Centre for Development of Telematics New Delhi; (iii) IIT, Bombay and (iv) IIT, Delhi respectively for this purpose.
- It comprises of 14 Technical Groups. They are selected through a highly competitive process and will specialize in key quantum verticals, ensuring a comprehensive and robust development of Quantum Computing, Quantum Communication, Quantum Sensing & Metrology, and Quantum Materials and Devices.
- These hubs will look for 'generation of new knowledge through basic and applied research' and simultaneously 'to promote R & D in areas that are mandated to them'.
- These hubs, committed to advancing quantum research and innovation, will support India in becoming a global leader in quantum technology, strengthening the nation's position at the cutting edge of scientific progress.
- These hubs will lead cutting-edge research and innovation, laying the groundwork for India to emerge as a leader in quantum computing, communication, sensing and materials.
- The T-Hubs will play a pivotal role in advancing quantum technology, fostering skilled human resources, promoting entrepreneurship, strengthening industry ties and enhancing global collaborations.
- A major advantage of the T-Hubs lies in their interdisciplinary approach, uniting specialists from various domains like Physics, Computer Science, Engineering, Material progress in quantum technologies.
- Each T-Hub will function under the Hub-Spoke-Spike framework, supporting a network of collaborative research initiatives (Spokes) and individual research teams (Spikes), alongside the central Hubs, to boost coordination among institutions and optimize resource and knowledge sharing.
- A total of 152 researchers from 43 institutions across India contributed to this exceptional national effort, highlighting the country's collective ambition to lead in this emerging field of QT.

Institutional involvements in Various T-Hubs:

1. **Quantum Computing:** IISc, Bengaluru.

   Other Institutions Involved: IIT Delhi, IIT Kanpur, IIT Roorkee, IIT Bombay, IIT Madras, IIT Ropar, IIT Guwahati, IIT Patna, BITS Hyderabad, IMSc Chennai, JIIT Noida, SETS Chennai, CDAC Bengaluru, IIT Indore, IISER Thiruvananthapuram, IISER Pune, RRI Bengaluru, NISER Bhubaneswar, TIFR Mumbai, TIFR Hyderabad and JNCASR Bengaluru.

2. **Quantum Communication:** IIT, Madras.

   Other Institutions Involved: ISRO Ahmedabad, ISRO Satellite Centre, IIT Delhi, IIT Kanpur, IIT Kharagpur, IIT Bhilai, IIT Roorkee, IIT Jammu, IIT Tirupati, IIT Patna, IIT Indore, IIT Hyderabad, IISc Bengaluru, IISER Bhopal, IISER Mohali, RRI Bengaluru, HRI Prayagraj, IIST DOS Thiruvananthapuram, CDAC Bengaluru, C-DAC Thiruvananthapuram and SETS Chennai.

3. **Quantum Sensing & Metrology:** IIT, Bombay.

   Other Institutions Involved: IISc Bengaluru, IIT Madras, IIT Delhi, IIT Kanpur, IIT Gandhinagar, IISER Bhopal, IIT Ropar, TCG CREST Chennai, TIFR Bombay, TIFR Hyderabad, HRI Prayagraj, IACS Kolkata, BITS Goa, University of Hyderabad and SN Bose NCBS.

4. **Quantum Materials & Devices:** IIT, Delhi.

   Other Institutions Involved: IIT Bombay, IIT Madras, IIT Kanpur, IIT Roorkee, IIT Kharagpur, IIT Bhubaneswar, SSPL-DRDO Delhi, IACS Kolkata and IISER Pune.

Proposals:

- The NQM launched its Call for Proposals (CFP) in January 2024, inviting leading academic institutions and R & D centres to submit project proposals in the four critical quantum verticals. The response was overwhelming with 384 proposals submitted from pan India.
- A rigorous evaluation process led to the selection of 17 proposals, representing the highest calibre of quantum research.

Significance:

- The NQM has the capacity to transform India's technology development landscape, pushing it toward global excellence and competitiveness.
- It stands to significantly impact a wide range of sectors—such as communication, healthcare, finance, and energy—with practical uses in areas like drug discovery, space exploration, banking, and national security.
- The mission will strongly support key national initiatives like 'Digital India', 'Make in India', 'Skill India', 'Stand-up India', 'Start-up India', 'Atamnirbhar Bharat', and the UN's Sustainable Development Goals.
- It will fast-track economic growth driven by quantum technologies and position India as a global frontrunner in the development and application of quantum solutions across domains like healthcare, defence, energy, and data protection.
- The initiative will spur the creation of homegrown technologies for developing quantum computers that are exponentially more powerful, capable of solving complex challenges securely and at unprecedented speed.
- Research & Development Acceleration: It will enhance R & D efforts in quantum computing, quantum communication, quantum sensing, and quantum materials.
- Ultra-Secure Communication: It will enable the creation of quantum networks that support ultra-secure, high-speed communication.
- High-Performance Computing: The development of 1,000-qubit quantum computers will make it possible to solve problems currently beyond the reach of classical computing.
- Precision Technologies: There will be major advancements in technologies like magnetometers and atomic clocks, enabling cutting-edge scientific breakthroughs.
- It will strengthen the innovation ecosystem by establishing T-Hubs that promote collaboration and knowledge exchange across multiple disciplines and industries.

Challenges:

Poor Expenditure on Research: Although government provides fund for the NQM, spending on R & D in India remained about 0.64 % of GDP which is very low in comparison to global standards. Most of the developed countries spend more than 2% of their GDP on R & D.

Lack of Private Investment: India's private sector lags behind the developed nations in the R & D investment, contributing less than 40% as compared to over 70% in the developed countries. This funding gap impedes access to crucial resources and slows down progress in the NQM.

Shortage of Skilled Professionals: The success of the NQM depends on a well-trained talent pool across disciplines such as Quantum Physics, Computer Science, and Engineering. However, India currently struggles with a considerable skills shortage, largely due to insufficient academic training programs and a weak connection between academia and industry.

Infrastructure Constraints: Setting up and maintaining advanced laboratories equipped with cutting-edge instruments and high-performance computing systems demands heavy investment and ongoing upgrades, which pose logistical and financial challenges.

Unclear Intellectual Property Framework: The absence of well-defined guidelines for the ownership and licensing of quantum-related innovations creates ambiguity, hindering commercialization and technological advancement.

Evolving Regulatory Environment: Updating current laws and introducing new regulatory frameworks to oversee quantum technologies, while accounting for ethical and national security concerns, requires deliberate and prompt policy measures.

Quantum Cybersecurity Risks: Developing and deploying encryption methods that can withstand quantum-based attacks is essential to protect existing digital systems from future cyber threats.

Path Ahead:

Encourage Private Sector Investment: Introduce tax-exempt zones and offer fiscal incentives, such as grants and subsidies, while exploring public-private partnership models to attract corporate investment in quantum research and development.

Launch Targeted Training Initiatives: Collaborate with academic institutions, research centres, and industry leaders to develop and implement specialized curricula in Quantum Science, Engineering, and Technology.

Enhance Regional Research Infrastructure: Direct funding toward building and upgrading quantum research facilities across various regions of India to ensure inclusive growth and equitable talent development.

Formulate Robust IP Policies: Create streamlined, transparent frameworks for the ownership, licensing, and transfer of quantum-related intellectual property to encourage innovation and commercialization.

Set Up a Dedicated Quantum Regulatory Authority: Establish a centralized regulatory agency focused exclusively on quantum technologies, responsible for developing and enforcing appropriate legal and ethical standards.

Support Technology Commercialization: Implement systems that facilitate the transfer of quantum research from academic labs to commercial applications, enabling industry to leverage emerging technologies.

Prioritize Quantum-Safe Encryption Research: Allocate resources to support the development of quantum-resistant cryptographic methods, ensuring future-proof security for critical data systems.

Conclusion:

Overall, while QT has enormous potential, there are still many challenges that must be overcome before it can be widely adopted.

The NQM is a Pan-India initiative under which four Thematic Hubs (T-Hubs) have been established, encompassing 14 Technical Groups spread across 17 States and 2 Union Territories. These hubs are engaged in a wide range of activities, including technology development, human resource development, promotion of entrepreneurship, industry partnerships, and international collaborations. The mission actively encourages the participation of female scientists from all states and districts across the country, ensuring inclusive access to and benefit from the various programs under NQM.

The NQM fosters collaboration between academic institutions, industry, start-ups and government entities to seed, nurture and scale up research in quantum technologies across these four verticals. The NQM aims at empowering research institutions and start-ups by providing essential funding, infrastructure and a conducive environment for collaboration and growth. To further support the development of quantum technologies, the NQM has prepared detailed guidelines aimed at nurturing start-ups in this emerging field. The NQM will also facilitate critical national and international partnerships, ensuring India stays at the forefront of technological advancements while building the capacity of its researchers. The NQM will ensure the sustained growth and development of the T-Hubs throughout its period, setting the stage for India's leadership in Quantum Technologies. This approach will create a robust network of research initiatives and collaborations across the nation, ensuring comprehensive growth in quantum technology development.

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Report (RC-04)

Workshop of IAPT-APhO Cell at Bhagwanti SVM Inter College Muzaffarnagar, Uttar Pradesh

A one-day Hands-on Workshop on Performance-Based Olympiad Level Experiments (POLLEX-XXI) was successfully organized on March 1, 2026, at Bhagwanti SVM Inter College, Muzaffarnagar, U P. The programme was conducted by the Indian Association of Physics Teachers (IAPT) – APhO Cell in collaboration with IAPT Regional Council–04 (UP region). The workshop aimed to enhance students' experimental skills through old Asian Physics Olympiad (APhO) experiments and performance-based learning activities. The event witnessed enthusiastic participation from students, teachers, and academic experts. The programme was graced by distinguished academicians, including Prof. B. P. Tyagi, Chief Coordinator, IAPT; Prof. Davesh Tyagi, HOD Physics, DAV PG College and President, IAPT RC-04; and Prof. T. N. Surya, Vice President, IAPT RC-04 and HOD Physics, Vardhman College, Bijnore, U P., Prof. Vijay Kumar, Coordinator, IAPT-APhO Cell and Principal, Dhanauri PG College, Haridwar, played a significant role in coordinating and guiding the workshop activities. The resource persons included Dr. Avijit Chamoli, Assistant Professor, Graphic Era Hill University, Dehradun; Ms. Rockey Choudhary, Assistant Professor, BFIT Dehradun; and Ms. Sneha Bisht, who provided hands-on guidance to the participating students. Importantly, Dr. Vandana Sharma, Principal of Bhagwanti SVM Inter College, Muzaffarnagar, along with the dedicated faculty members of the institution, played a pivotal role in the successful organization and smooth execution of the workshop. Their support, coordination, and active involvement ensured that the event was conducted efficiently. Prof. Yogesh, Prof. Neeraj, and Prof. Akshay from DAV College, Muzaffarnagar, along with technical staff and M.Sc. students of DAV PG College, Muzaffarnagar, also actively participated and contributed to the success of the workshop. The workshop provided an excellent platform for students to perform and understand advanced physics experiments at the Olympiad level. Participants appreciated the interactive sessions and practical exposure. The programme concluded with a vote of thanks, reaffirming IAPT's commitment to strengthening physics education and nurturing young scientific talent.

Vijay Kumar
Coordinator, IAPT-APhO

Demonstration Activity: Light-Matter Interaction and Golden Ratio SciQuest 2026

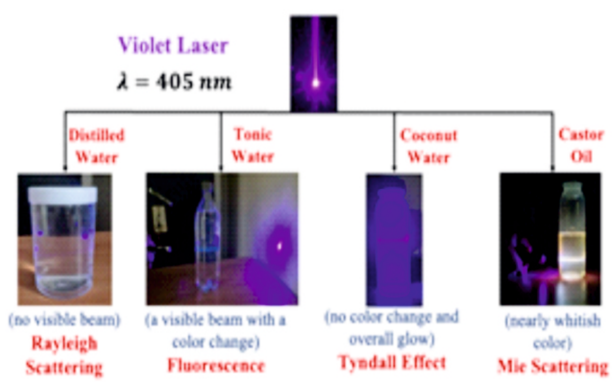
On the occasion of National Science Day and National Mathematics Day, the Indian Institute of Information Technology Vadodara (IIITV), in collaboration with the Indian Association of Physics Teachers (IAPT), conducted a demonstration activity on "*Light-Matter Interaction: Raman Effect and Scattering Mechanisms*" and "*Golden Ratio*" under the Institutional Event, *"**SciQuest 2026**"*, held from 11th-12th February 2026.

The event was inaugurated at 11:00 AM by Honourable Prof. Dharmendra Singh, Director, IIITV along with Dr. Ajay Nath, Associate Dean (Student Affairs), Dr. Dhirendra Sinha, Head, Department of Applied Physics, and Dr. Swapnil Lokhande, Head, Department of Mathematics and Computing. In his inaugural address, Prof. Dharmendra Singh emphasized the vital role of such activities in shaping critical thinking and how this approach can lead to significant discoveries. He also highlighted the value of becoming a "mixture," underscoring that while collaboration enriches learning, every individual retains a unique identity.

The first session featured a demonstration on "*Light-Matter Interaction: Raman Effect and Scattering Mechanisms*", presented by Priyaranjan Tiwari, Kalash Desai, Palin Jena, and Hrishikesh Pathak (B.Tech. 1st year).

Priyaranjan Tiwari demonstrated that when 405 nm violet light passes through distilled water, no visible beam is observed whereas tonic water exhibits a noticeable color change. He explained that since the wavelength of incident light is much larger than the size of the water molecules (~0.27 nm), photons undergo weak interaction, resulting in Rayleigh scattering with no change in wavelength. In contrast, tonic water contains quinine, a fluorescent compound that absorbs high-energy photons and re-emits low energy cyan/blue light through Fluorescence.

Kalash Desai further demonstrated that shining the same light through Coconut water produces a visible beam without any color change. He explained that this occurs due to elastic scattering of light by suspended particles such as proteins and lipids (approximately 100-500 nm in size), a phenomenon known as Tyndall effect. Subsequently, Palin Jena used castor oil, where a bright, nearly white beam was observed. He explained that larger suspended impurities and colloidal particles (on the order of micrometres), elastically scatter the light, and cause Mie Scattering. Multiple scattering events lead to a bright, opaque path that appears white to the human eye.



Finally, Hrishikesh Pathak introduced the **Raman effect**, explaining that when light falls on a substance, most light scatters without any color change, however, a small fraction (approximately 1 in 10^6 -10^8 photons) undergoes inelastic scattering, leading to a shift in wavelength. He mentioned that although the Raman effect is present in all the above demonstrations, it is extremely weak compared to elastic scattering and fluorescence, hence cannot be observed with the naked eye. Its detection requires sensitive instruments such as a Raman spectrometer.

The second demonstration was presented by **Kartikey Singh and Ishika Awasthi** (B.Tech. 1st year) on the concept of "***Golden Ratio***". They illustrated the presence of the **Fibonacci sequence** in nature through examples such as floral patterns, spiral arrangements in pineapples, pinecones, rose petals, and seeds patterns in sunflowers. They explained that the concept originated with the Indian mathematician **Pingala** (200-450 BCE), later expanded by **Virahanka, Gopala, and Hemachandra**, and subsequently popularized in Europe by **Leonardo Fibonacci**, after whom the sequence is named. They mentioned that the ratio of two consecutive Fibonacci numbers approaches approximately **1.618**, known as the **Golden Ratio**, which is widely used in mathematics, nature, art, and design.

Through various examples, they demonstrated the presence of Golden ratio in galaxies and ocean waves, human body proportions (such as the distance from the head to the navel and from the navel to the feet, the length of the shoulder to the elbow and the elbow to the fingertips, and even in the shape of the ear and a clenched fist), as well as in renowned structures and artworks like the **Eiffel Tower, Mona Lisa**, and the **Taj Mahal**.

This event also featured a multidisciplinary Science Quiz covering Physics, Mathematics, Electronics and Communication Engineering, Computer Science and Engineering, and Environmental Science. Participants displayed remarkable enthusiasm, creativity, and curiosity. The winners of the quiz were: Palin Jena, Kalash Desai, and Priyaranjan Tiwari (B.Tech. 1st year), who secured the First Prize. The second prize was awarded to Anish Kharat, Kartik Rathod, and Atharva Patil (B.Tech. 3rd year), while Harshit Verma, Aditya Vikram, and Mayank Naharwal (B.Tech. 1st year) secured the Third Prize.

The event was meticulously planned and executed under the guidance of Dr. Payal Wadhwa (Dept. of Applied Physics) who oversaw theme development, student mentoring, demonstration scripting, question design (Physics), execution, evaluation, and result compilation. The demonstration on Light-Matter interaction was inspired by Prof. Y. K. Vijay's session at ICPE 2025 and further developed through discussions with Dr. Nagendra Kumar (Dept. of Applied Physics), while the Golden ratio demonstration was developed in consultation with Dr. Swapnil Lokhande and Dr. Sumit (Dept. of Mathematics and Computing). Quiz questions from various disciplines were contributed by Dr. Sumit and Dr. Juhi Jaiswal (Dept. of Mathematics and Computing); Dr. Sanjeev Mani Yadav (Dept. of Electronics and Communication and Engineering); Dr. Pramit Majumdar and Dr. Sanjay Saxena (Dept. of Computer Science and Engineering), and Dr. Priyanka Mishra (Dept. of Humanities and Social Sciences). The event received valuable guidance and planning support from Dr. Ajay Nath, Dr. Dhirendra Sinha, Dr. Mukesh Kumar (Dept. of Applied Physics) and Dr. Pooja Mishra and Dr. Ashish Singh (PIC Academics). The successful execution of the event was supported by dedicated student volunteers: Rashi Jain, Damini Kushwaha, Soha Mehak, Priyanshu Bhatt, Avanish Bhanu, Kartikey Singh (B.Tech. 1st Year), Kushal Shah (M.Tech. 1st Year) and Surbhi Kumari (Ph.D. Mathematics and Computing). All demonstration materials and logistical requirements were arranged with the help of Mr. Ronak Nayi (Administrative Assistant, IIITV).

The success of ***SciQuest2026*** reflects a collective commitment to promote scientific curiosity, critical thinking, and the relevance of Physics and Mathematics in everyday life.

Payal Wadhwa

Celebration of National Science Day

The Department of Physics of S.D. College, Barnala celebrated National Science Day 2026 on 3rd March 2026 in the college campus in association with the Departments of Mathematics and Science under the aegis of IAPT. On this occasion, three Inter-College events, Poster Presentation, Power Point Presentation, and Quiz Competition were organized. 100 students from around 10 nearby colleges participated in all the three competitions and making the event informative and engaging.

A major attraction of the program was the "Lab on Wheels" exhibition presented by educationist and National Award-winning scientist Jaswinder Singh. During his interactive session, he explained the scientific reasoning behind the religious number 108 and the importance of the number 9 in a very interesting way. He also demonstrated working models explaining the concepts of the Raman Effect, rocket propulsion, and space and vacuum.

Through simple experiments and demonstrations, he highlighted that scientific principles are not limited to textbooks but are deeply connected with our daily lives. His inspiring presentation generated curiosity and interest in science among the students.

In the morning session, Dr. Vandana Kukreja welcomed the participants and formally inaugurated the competitions. The stage was conducted by Dr. Baltej Singh, Head of the Department of Physics, who welcomed the guests and highlighted the achievements and journey of the department. On this occasion, Dr. Manoj Kumar Gupta, Convener of the event, introduced the guest speaker Dr. Jaswinder Singh.

The Director of S.D. College Institutions, Hardiyal Singh Attri, emphasized the importance of such academic events in encouraging scientific thinking and innovation among students.

Nandika, a student of S.D. College, Barnala was honoured with a certificate, trophy, and a cash prize of ₹ 1100 for securing the Punjab State Topper position in the NGPE-2025.

The department expressed its gratitude to the **RC-2** for providing financial support. The organizers also thanked the management of S.D. College Institutions and Principal Dr. Rama Sharma for their continuous encouragement and support.

Finally, Sanjay Kumar Singh presented the vote of thanks and acknowledged the enthusiastic participation of the students, the hard work of the organizing team, and the support and motivation provided by the management of S.D. College Institutions and Principal Dr. Rama Sharma.

Manoj Kumar Gupta
S. D. College Barnala, Punjab

Report (RC-15)

National Science Day 2026 Celebration

This year National Science Day was celebrated by IAPT RC15 in two phases, (on 28th February and on March 01) one offline and the other online. On 28th February, a programme was jointly organized with Bangabasi College, Kolkata at the College auditorium. Good number of students and teachers from the College and some of the IAPT Life Members were present in the programme. After a compact inaugural session where Dr Surajit Chakrabarti from IAPT briefly talked about IAPT and its activities the academic sessions began.

The first talk was on 'Vedic Mathematics: Ancient Wisdom, Modern Efficacy' by Prof Seema Sarkar (Mondal) from NIT Durgapur. She talked about the Vedic way of performing the basic mathematical operations of addition, subtraction, multiplication and division.

The second session was conducted by one of the senior members of IAPT, Dr Bhupati Chakrabarti, a retired Associate Professor in Physics of City College, Kolkata. The title of his session was 'Observe and Explain.' It was an interactive session where Dr Chakrabarti underlined some experimental observations by performing a few small and simple experiments with rudimentary materials. The students were asked to explain the observations from the scientific points of view. They were also asked to perform some of the experiments by themselves. The students showed a lot of involvement and interest in the experiments and tried to offer the relevant scientific explanations. In the next session Dr Biswanath Banerjee, Retired Sr. Manager (Research) from the Damodar Valley Corporation (DVC) talked about soil chemistry and shared some of his experiences at DVC.

After lunch break, another senior member of IAPT, Dr. Achintya Pal who is a retired Senior Scientist of ONGC and with interest in observational astronomy delivered a lecture titled 'Astronomy Made Interesting and Entertaining.' In this talk Dr Pal introduced the sky, different constellations, and other aspects of observational astronomy in a very simple way. He talked about his own experience in sky observations from high seas. Dr Pal displayed some of the photo graphs of the sky that he himself took and he could underline how some of the planets and stars could be seen very clearly there.

The last session belonged to the students of the College where some of them briefly talked about the interesting projects on frontline areas like AI and Chatbot they are working with. There was also a poster session where the students of the College displayed some of the scientific ideas in well-designed posters.

Overall, it was a descent programme and IAPT RC-15 is extremely thankful to Bangabasi College and its Principal, Dr Himadri Bhattacharyya Chakrabarty and to Dr Lipika Santra, Head, Department of Physics of the College, and an IAPT Life Member for the great success of the NSD 2026 celebration.

Inaugural session at Bangabasi College on February 28

A session in progress

Celebration of National Science Day by RC 15 on 1st March,2026

A webinar titled "Introduction to Non-linear Dynamics and Chaos Theory" was organised on 1 March 2026. The objective of the webinar was to introduce participants to the fundamental concepts of nonlinear systems and highlight their significance in understanding complex phenomena observed in nature.

The distinguished speaker for the event was Prof. Soumitro Banerjee, Former Professor at the Department of Physical Sciences, IISER Kolkata, and also of IIT KGP and an awardee of Bhatnagar Prize delivered an insightful lecture on the area.

The webinar began with a brief discussion on the traditional role of linear system theory in scientific analysis. Linear systems have long been used as convenient mathematical approximations because they are easier to analyze and often provide useful insights into system behaviour. However, Prof. Banerjee emphasized that most real-world physical systems are inherently nonlinear in nature. Over the past several decades, researchers across various scientific disciplines have increasingly recognized that nonlinearity is not merely an exception but a fundamental characteristic of natural systems. Consequently, the development of appropriate theoretical tools and analytical techniques has become essential for understanding nonlinear phenomena.

Building upon the familiar framework of linear systems, the speaker gradually introduced the core ideas of nonlinear dynamics. The session illustrated how nonlinear systems can exhibit a rich variety of behaviours that cannot be explained using linear models alone. Unlike linear systems, nonlinear systems may respond to small variations in initial conditions with dramatically different outcomes, often leading to complex and sometimes unpredictable patterns of motion.

One of the important topics discussed during the webinar was the concept of limit cycles, which represent stable periodic oscillations that arise in certain nonlinear systems. Limit cycles occur when a system's trajectory in phase space converges to a closed path, resulting in sustained oscillatory behaviour that is largely independent of initial conditions. The speaker also introduced the concept of higher-period orbits, where systems repeat their motion only after several cycles, producing more intricate periodic patterns.

Another phenomenon discussed was quasi-periodicity, in which a system exhibits oscillations characterized by multiple independent frequencies that do not share a simple integer ratio. As a result, the system displays motion that remains ordered yet never exactly repeats itself. The session concluded with an introduction to chaos, one of the most fascinating features of nonlinear systems. Chaotic behaviour arises in deterministic systems that exhibit extreme sensitivity to initial conditions, leading to outcomes that appear random despite being governed by precise mathematical laws.

Overall, the webinar provided a clear and well-structured introduction to nonlinear dynamics and chaos theory. The session successfully highlighted the growing importance of nonlinear analysis in modern scientific research and its wide relevance across diverse fields of science and engineering.

Shinjinee Das Gupta

Report (RC-18)

Celebration of National Science Day

A one-day National Science Day 2026 celebration on 28th February 2026, was organised by the Department of Physics, Manipur University at the Department's Seminar Hall. The celebration was sponsored by Manipur University (MU), and RC-18. The theme of this year's National Science Day was "**Women in Science: Catalyzing Viksit Bharat."** The theme aligns scientific advancement with India's vision of becoming a developed nation by 2047 while recognizing the role of women researchers and innovators of our country.

The celebration was inaugurated by Prof. Sumitra Phanjoubam, Dean, School of Mathematical and Physical Sciences, MU, as the Chief Guest and Prof. Angom Dilip Kumar Singh, Department of Physics, MU, as the Guest of Honour at 10.00 AM, at the Seminar Hall of Department of Physics, Manipur University. The President of the function was Prof. Th. Gomti Devi, Head, Department of Physics, Manipur University. The Resource Person was Prof. N. Rajmuhon Singh, Former Vice-Chancellor of Dhanamanjuri University,Manipur.

The Chief Guest spoke about the significance of celebrating National Science Day and highlighted the role of women in science and their contributions to building a developed India. The Guest of Honour addressed the issue of domestic violence against women in Manipur and emphasized the importance of women's upliftment in society.

In her presidential address, Prof. Th. Gomti Devi explained the Raman Effect and the reason for celebrating National Science Day every year on 28th February. She stressed the vital role of society and family in encouraging women and fostering their interest in science and research. Following the inaugural function, the Resource Person delivered an inspiring and engaging lecture on the significance of National Science Day. His talk was highly motivating for teachers, researchers, and schoolchildren.

Students of classes 8th to 10th from nearby Government schools were invited to attend the celebrations and listen to a lecture delivered by the invited resource person. A total of fifty-five students, accompanied by ten teachers, attended the celebration.

The students from Langthabal Nambul Mapal Junior High School, Kha -Imphal, Chingamakha, Heirangoithong and Kiyamgei Ideal High Schools participated.

A Laboratory visit to the Department of Physics, Manipur University, was arranged to provide students with exposure to research facilities and experimental setups.

A Science exhibition was arranged that showcased fundamental phenomena in Physics and Mathematics through interactive demonstrations and models. The displayed model included the kits obtained from the Vikram Sarabhai Community Science Centre and other models designed by M.Sc and PhD students.

The children were enthusiastic and excited to take part in the activities. Later, certificates of participation were distributed to the schoolchildren during the valedictory function. The total number of participants, including schoolchildren, M.Sc. and PhD scholars, was more than 100.

The organizing committee expressed sincere thanks to the M.Sc. students and research scholars for their excellent arrangement of the science exhibition and for effectively explaining various phenomena in Physics and Mathematics.

Th. Gomti Devi

Report (RC-23)

Celebration of National Science Day

Venue: St. Bede's College, Shimla & Zoom Platform

Date: February 24, 2026 & February 28, 2026

Organized by: St. Bede's College, Shimla in Collaboration with RC- 23.

National Science Day was enthusiastically celebrated with a series of engaging and educational activities organized by the Department of Physics, St. Bede's College in collaboration with IAPT.

On 24th February 2026, the program commenced with the screening of a documentary on Sir **C. V. Raman**, highlighting his life journey, struggles, and the ground breaking discovery of the Raman Effect. Following the screening, a quiz competition based on the documentary was conducted. The session was interactive, intellectually stimulating, and witnessed enthusiastic involvement from the participants.

Dr. Sapna Sharma, Head of the Department of

Physics, delivered an inspiring talk on the theme "Unsung Heroes of Science." She shed light on lesser-known women scientists whose remarkable contributions have significantly shaped scientific progress.

An exhibition of working models prepared by students of the Physics Department was another highlight of the celebration. The models demonstrated various scientific principles and reflected the students' creativity, teamwork, and practical understanding of theoretical concepts. The Principal of the college, Dr. (Sr.) Rosily T.L, addressed the gathering and encouraged students to cultivate a scientific mind set. She emphasized the importance of research, innovation, integrity, and dedication in contributing meaningfully to society.

On 28th February 2026, the program was organized as a webinar with the objective to celebrate India's scientific achievements and to deliberate upon the role of women in shaping the scientific landscape of the country. The session began with National Science Day greetings, followed by a warm welcome address by Dr. Sapna Secretary, RC23.

The webinar featured two eminent speakers: Dr. Y. C. Kamala, an experienced physics educator, and Prof. P. K. Ahluwalia, President, IAPT. The session was presided over by Prof. Kuldeep Sharma,President, RC-23.

Prof. Y. C. Kamala delivered a thought-provoking lecture on the theme **"Women in Science: Catalysing Viksit Bharat."** She emphasized the importance of increasing women's participation in science and research to achieve India's developmental goals by 2047. Presenting relevant data, she highlighted the existing gender gap in scientific careers. She drew attention to the "leaky pipeline" phenomenon between Ph.D. completion and appointments in scientific institutions and stressed the need for policy interventions. She also advocated for supportive measures such as the establishment of crèches in workplaces to assist working parents. While appreciating the government's initiatives to enhance women's participation in science, she underscored the need for sustained, collaborative efforts across sectors.

Prof. P. K. Ahluwalia delivered an insightful lecture on the life and scientific contributions of **C. V. Raman**, elaborating on his pioneering work and the discovery of the Raman Effect. He also spoke about the inspiration Raman drew from leaders such as Jawaharlal Nehru. Prof. Ahluwalia recommended several books for further reading on Raman's life and legacy, encouraging participants to explore the depth of his scientific journey.

The session was highly informative and well-received by the audience. The program concluded with a formal vote of thanks proposed by Dr. Sapna expressing gratitude to both speakers and participants for their valuable contributions.

Both the programs successfully celebrated the spirit of National Science Day while reinforcing the importance of women's empowerment in science as a cornerstone for achieving the vision of *Viksit Bharat*.

Sapna Sharma
Convener

Activities

Report (SRC-08C)

Activity -1: Night Sky Observation The Night Sky Observation program was organized on 21 February 2026 by the Department of Physics, RKMM, Ahililyanagar, in association with RC-08C (Pune), under the coordination of Dr. Shankar Kekade. The event successfully engaged more than 150 students, offering them an enriching experience that combined lectures on astronomy and astrophysics with hands-on sky observation.

Program Highlights

First Lecture

- Speaker: Mr. Rupesh Labade

- o Introduced IUCAA and its role in astrophysics research.
- o Discussed diverse career opportunities in Astronomy and Astrophysics.
- o Explained the working principle of telescopes, their types, and applications.

Second Lecture

- Speaker: Mr. Tushar Purohit
  - o Shared his personal journey in Astronomy.
  - o Demonstrated how to build low-cost telescopes.
  - o Narrated experiences with IIT, IISER, and NDA.
  - o Provided practical guidance on conducting night sky observations.

Sky Observation Session

- Time: Began at 7:45 PM
- o Nearly 150 students actively participated.
- o Observed celestial objects including the Moon and Jupiter.
- o Both speakers guided students in telescope handling and observation techniques.

Student Response

- Students expressed high enthusiasm and positive feedback.
- Many were thrilled to witness the Moon and Jupiter through the telescope for the first time.
- The program successfully sparked curiosity and excitement about Astronomy.

Conclusion

The *Night Sky Observation* event was a resounding success. With engaging lectures and hands-on sky observation, students gained both theoretical knowledge and practical experience. The collaboration between RKMM Physics Department and IAPT 08C provided a valuable platform to inspire young minds toward careers in Astronomy and Astrophysics. Dr. S. R. Thopate, Principal of RKMM College, Ahilyanagar, expressed his appreciation to IAPT SRC 08C for extending financial support, which played a crucial role in successfully accomplishing this event.

Activity- 2: Poster Competition On 20 February 2026, a Poster Competition was organized at K. J. Somaiya College of Arts, Commerce and Science, Kopargaon under the guidance of Principal Dr. V. C. Thange and co-ordinated by Dr. Nilesh Pote in association with RC-08C (Pune). The event saw enthusiastic participation from 52 UG and PG students, who presented posters on diverse themes such as Quantum Computing, Artificial Intelligence, Electric Vehicles, Solar Energy, ISRO Missions, Data Encryption, and Quantum Entanglement. An invited talk was delivered by Dr. Shashikant Shinde, Secretary RC- 08C, on the topic **"Beyond the Lab: Career Pathways in Physics",** which inspired students to explore the wide range of opportunities available in the field of physics.

Program Highlights

The competition showcased posters on diverse and contemporary themes such as Quantum

Computing, Artificial Intelligence, Electric Vehicles, Solar Energy, ISRO Missions, Data

Encryption, Quantum Entanglement, and more.

Students demonstrated creativity and scientific understanding by presenting innovative ideas through visual and conceptual designs.

Invited Talk

Speaker: Dr. Shashikant Shinde, Secretary RC-08C

Topic: Beyond the Lab: Career Pathways in Physics

- o Emphasized the wide range of opportunities available for physics graduates beyond traditional research.
- o Highlighted interdisciplinary applications of physics in technology, industry, and innovation.
- o Motivated students to explore careers that connect

scientific knowledge with societal needs.

Outcome & Response

The event provided a platform for students to express their scientific curiosity and creativity.

Participation from both UG and PG students ensured a rich exchange of ideas.

The invited lecture inspired students to think about their future careers in physics and related fields.

Overall, the competition was successful in fostering scientific temperament and enthusiasm among young learner.

Prize	Name of Student	Class	Name of Poster
First	1. Deshmukh P. J. 2. Kadam D. A. 3. Prasad M. J.	FYBSc	Future Technologies
Second	1. Khairnar S. N. 2. Khandizod S.V.	TYBSc	Quantum Computing
Third	1. Patil S. S. 2. Kalwaghe R. R.	SYBSc	Future Technologies
Consolation	1. Rohamare D. S.	FYBSc	Quantum Entanglement
Consolation	1. Barge B. R.	SYBSc	Solar Cell

Shashikant Shinde,
Secretary

Report (RC-21)

Annual Convention- Goa

The Annual Convention of the RC-21, Goa Regional Council was held on 14 March 2026 at Smt. Prabhavati Ankush Shirodkar Higher Secondary School, Shiroda, Goa. Around 120 Physics teachers and students from higher secondary schools, colleges, and universities participated. The event was organized in association with the Goa State Council of Educational Research and Training.The Chief Guest for the inaugural function was Shri Subhash Shirodkar, Hon'ble Minister for Water Resources Development, Co-operation, and Provedoria and Chairman of Shivgram Education Society. The programme began with an invocation dance by students of Symbiosis School, Shiroda. The convention was formally inaugurated with the ceremonial lighting of the electric lamp. Smt. Shubhada Shirodkar, Convenor, delivered the welcome address, followed by the Presidential Address by Prof. Satish Keluskar, President of Goa RC. Dr. Reshma Raut Dessai, Secretary, provided an overview of the association's activities and outlined the day's sessions.

In his inaugural address, Shri Shirodker expressed concern over the declining number of admissions to the Science stream at the HSSC level. He stressed the importance of nurturing a practical mindset and encouraged students to visit premier institutions such as ISRO, BARC, and TIFR to gain firsthand exposure to research and innovation.

The scientific sessions covered diverse topics. The keynote address by Dr. S. Seetha, former Director of the Space Science Programme ISRO, focused on applying fundamental B.Sc. and M.Sc. Physics concepts to space science. She discussed X-ray astronomy, detectors aboard AstroSat, and fundamental phenomena such as the Photoelectric Effect, Compton Effect, and X-ray Fluorescence, connecting them to Indian space missions like Chandrayaan-2 and 3.

The experimental session conducted by Dr. Vinayak K. Pattar from JNCSR, Bangalore, included hands-on demonstrations of the Tyndall Effect, diffraction using a CD, Total Internal Reflection, Quantum Locking in superconductors, and cloud formation with liquid nitrogen. The interactive session reinforced conceptual understanding through practical engagement. Dr. C. Sudhir of Goa University delivered a talk on optical forces arising from light-matter interactions, discussing radiation pressure, solar sails, optical trapping, Optical Tweezers and advances in nanophotonics for nanoscale manipulation. Dr. Santosh Kumar Das from IIT Goa presented on "Recreating Big Bang Matter on Earth," explaining quark interactions, Quark-Gluon Plasma, and the microscopic conditions of the early universe. It provided insights into the microscopic conditions of the early universe and their connection to the Big Bang and the formation of the universe.

Post-lunch, the Annual General Body Meeting was held for all IAPT Goa RC members. Reports of activities conducted over the year, the audited statement of accounts, and future plans for 2026-27 were presented. Suggestions and questions under AOB were discussed by members.

The Chief Guest for the valedictory function was Shri Sachin Shirodkar, Director of Rayeshwar Institute of Technology, Goa, and the Guest of Honour was Dr. Sameer Patil, COE of Goa University. Participants shared their feedback and expressed satisfaction with the sessions. Toppers of M.Sc. and B.Sc. in Physics and Electronics, the HSSC topper in Physics, and Ph.D. awardees were felicitated. Four superannuated Physics teachers, Shri Rajeev Desai, Smt. Tanuja Sardesai, Smt. Nutan Bhandari, and Shri Prashant Chodankar were honored for their contributions to Physics education.

In his address, Dr. Sameer Patil recommended organizing experimental skill-testing workshops to enhance practical competencies and suggested that students undertake interdisciplinary projects in collaboration with institutions such as NIO, NIIT, and engineering colleges to engage in meaningful research.

The Chief Guest expressed his happiness at participating, noting his background as a physicist. He emphasized that Physics should inspire genuine interest rather than be treated merely as a subject choice. Appreciating the students' feedback, he remarked on the bright future of Physics when young generations recognize the value of such conventions. He assured his support to IAPT and stressed that the beauty and societal relevance of Physics must be communicated to students through initiatives like this. He also commended the organizing team for their efforts.

Finally, Dr. Reshma proposed the vote of thanks. She expressed her delight at the convention's success and extended gratitude to the resource persons, organizing team, and participants. She also thanked the management of Smt. Prabhavati Ankush Shirodkar Higher Secondary School, Shiroda for hosting the event and GSCERT for granting duty leave to HSS teachers to attend. The convention successfully combined motivation, practical learning, and recognition of excellence, inspiring participants to pursue Physics and contribute meaningfully to Science and Technology.

Resource persons : Dr. Seetha, Dr. Pattar, Dr. Sudhir, and Dr. Santosh.

Reshma Raut Dessai
Secretary

Report (SRC-08B)

Winter School on Optics and Modern Physics

Organized by: Department of Physics, Gogate Jogalekar College, Ratnagiri &SRC-08B

Duration: 26 to 30 December 2025 Winter School focusing on Optics and Modern Physics was organized at Gogate Jogalekar College, Ratnagiri. The program aimed to bridge the gap between theoretical physics and practical application for undergraduate students.

The School saw an enthusiastic response from the academic community across Maharashtra, with 55 undergraduate students from 11 different institutes registering for this intensive course. The overall planning and execution were spearheaded by Dr. Vivek Bhide, Vice President of SRC-08B. The administrative team included:

● **Convener:** Dr. B B Dhale (Gogate Jogalekar College, Ratnagiri)

● **Course Coordinator:** Dr. Meera Kale (Athalye Sapre Pitre College, Devrukh)

● **Co-coordinator:** Mr. Padmanabh Sarpotdar (Khare Dhere Bhosale College, Guhagar)

The event was formally inaugurated by Dr. Anil Raghav, Professor, University Department of Physics, University of Mumbai, while Prof. Atul Mody represented the IAPT at the concluding ceremony. Prof Kiran Kolavankar from IAPT SRC 08B talked about the career opportunities in Physics.

The curriculum was designed to cover diverse areas of physics through expert-led sessions:

Four enrichment lectures were organized on the following topics:

Space weather: by Prof. Anil Raghav, University Dept. of Physics, University of Mumbai

Radio Astronomy: by Mr. Padmanabh Sarpotdar, KDB College, Guhagar

Camera Optics: by Mr. Mahesh Shetti, Wilson College, Mumbai

Quantum Technology: by Dr. Atul Mody, Mumbai

● **Modern & Quantum Physics:** Dr. Vivek Bhide provided an in-depth introduction to the Postulates of Bohr's Theory, de Broglie hypothesis, Wave-Particle Duality and uncertainty principle. Dr. Mody discussed the mathematical framework of the Hydrogen atom, spectroscopy and introduced elementary particle physics, the special and general theories of relativity.

● **Optics and Electromagnetism:** Dr. Mahesh Belekar conducted sessions on the Interference of Thin Films, Resolving Power and polarization, supplemented by laboratory demonstrations. Prof. Mahesh Shetty bridged the gap between theory and technology by discussing the Fundamentals of Ray Optics and the sophisticated optical systems used in modern mobile cameras. Dr. Kishor Sukhatankar discussed Maxwell's equations in Electromagnetism along with relevant laboratory demonstrations.

● **Sky Observation:** Prof. Babasaheb Sutar delivered a lecture on Basic Astronomy. This was followed by a practical sky-watching session where students used telescopes to observe Jupiter, the Moon, and Saturn and the Sunspots during the day time. The students also learned the practical application of magnification by manually changing the eyepieces.

A defining feature of this Winter School was the heavy emphasis on Physics problem-solving. Students were encouraged to engage in active calculations and participate vigorously in laboratory practical. To conclude the program, an 'understanding test' was given to evaluate the knowledge gained by the participants.

The success of the event was bolstered by the full cooperation of the Principal of the college Prof. Makarand Sakhalkar.. The program ended with a valedictory ceremony.

K G Bhole

National Competition in Computational Physics - 2026
(NCICP-2026)

(An Online Competition on Physics Simulations & Software-Based Physics Experiments)

Detailed information will be available on www.indapt.org.in from April 12, 2026 onwards.
Please visit the website regularly for updates and further details.

A. Competition Theme

21st Century Computational Tools for Physics Exploration and Discovery

B. Key Dates

- Event Registration Deadline (with submission of Title & One-Page Abstract) Date **May 31, 2026**
- Interaction with Experts (Online) Final Submission **Deadline June 15 – 21, 2026**
- Final Presentation & Interaction for Evaluation (Online) **July 31, 2026 August 20 – 31, 2026**
- Project Demonstration by Award Winners & Special Invitees About NCICP-2026 Objectives During IAPT Convention 2026

C. The National Competition in Computational Physics (NCICP-2026) aims to:

- Promote computational thinking, simulation-based analysis, and AI-driven problem solving in physics.
- Encourage students and researchers to develop innovative solutions for real-world physics challenges.
- Foster deeper engagement with computational physics through hands-on simulations and software-based experiments.
- Empower educators to integrate generative AI and advanced computational teaching tools.
- Enhance modern scientific exploration by leveraging technology-driven methodologies. This competition serves as a platform for participants to explore cutting-edge computational techniques, drive innovation, and contribute to the future of physics research and education. Competition Categories

D. Participant Categories, Subthemes and Scope

NCICP-2026 will have three (03) categories:

1. Undergraduate (UG)
2. Postgraduate (PG) & Research Scholars
3. Educators

How to register & how to participate and where to submit an Entry for competition

- The detailed entry should be submitted via the Google Form: https://forms.gle/p4A1XsVaEYsQr3Gt5
  An individual, or the team leader in the case of a group (maximum three members), must submit the required information, including a one-page abstract with title in PDF format, by May 31, 2026. Detailed information will be available on www.indapt.org.in from April 12, 2026 onwards. Please visit the website regularly for updates and further details.
- Selected entries (award winners and special invitees, if any) from each category will be invited to present demonstrations at the upcoming IAPT Convention. The dates and venue will be notified in due course. The convention is likely to be held in October 2026.
- All submitted work must be original. The judges' decisions will be final. The top three presentations in each category will receive prizes and certificates. All participants will receive an e-certificate. In addition, selected submissions (other than the top three in each category), as chosen by the judges, will have the opportunity to be included in an IAPT e-publication (in the form of a book).

For any query, contact:

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First Call

40th IAPT National Annual Convention 2026

(Ruby Jubilee Convention)

Organized by

INDIAN ASSOCIATION OF PHYSICS TEACHERS (IAPT) – REGIONAL COUNCIL 01 (RC01)

[DELHI & HARYANA]

in collaboration with

AMITY CHILDREN SCIENCE FOUNDATION, NEW DELHI

(October 04 - 06, 2026)

Venue

AMITY UNIVERSITY, NOIDA [DELHI NCR]

Theme: Emerging Technologies and Pedagogies in Physics Education

Detailed information: Keep watching Central IAPT Website

https://www.indapt.org.in/events/20311

Contact:
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Secretary, IAPT RC01
Mob. No. 9868516554

Trends and Themes in Physics Education Research (PER)

What Does it Mean to `Understand' Something?

The title may sound a bit too pedantic. However, it is one of the central issues that we grapple with, on a daily basis in physics education, implicitly or explicitly. The paper below talks about an incident of the author teaching systems of linear equations as a beginning teacher. She found that even those students whom she thought had a good grasp of the topic were not able to answer or solve certain types of questions. To her delight, there was one student in the class who could satisfactorily answer all the problems she posed. In a conversation with this student she told him that he was the only student in the class who `understood' what she taught. To her surprise, the student retorted angrily that he didn't `understand' anything, leaving both the teacher and student perplexed. This experience is not an isolated one, rather one which any reflective teacher or student experiences as long as they continue to `learn'. What can be called or felt as understanding often involves more than just the operational ability to derive equations or solve problems, which is discussed in the following paper.

Sfard, A. (1994). Reification as the birth of metaphor. *For the learning of mathematics*, *14*(1), 44-55. **https://www.jstor.org/stable/pdf/40248103.pdf**

The paper also attempts to account for more intriguing and elusive phenomena like `true insight' or`direct grasp', such as that shared by Gauss when he said: "*I have had my results for a long time: but I do not yet know how I am to arrive at them.*" We know that such episodes are not uncommon, and stories about great minds like Ramanujan are similar in spirit.

The author bases her account of the phenomena under consideration on interviews with research mathematicians. The argument is premised on the notion that bodily experiences constitute the primary sources of our `understanding'. The primary role of bodily experiences, or our sensory-motor interactions with the world, in building our understanding of science and mathematics is rather intuitive in cases like acquisition of a sense of what numbers are. However, as we climb the tower of abstraction and move to more involved concepts and ideas, an explanation for how they are rooted in the body is warranted. The notion of conceptual metaphor from cognitive linguistics is invoked to explain this - to give an account of `how the bodily works its way up to the conceptual'. Metaphors are considered structures that mediate this process, bringing into being complex, abstract concepts.

From the perspective of the growth of an individual, it is clear that the early years are marked by the predominance of bodily, sensory-motor interactions in making sense of the world around. The essence of these bodily, sensory-motor experiences is preserved for organizing future experiences through the formation of what are called embodied schemas. In other words, we are not empty vessels into which experiences keep getting dumped. Rather, structures or schemas are formed by virtue of our initial sensory-motor interactions, which then start organizing our further experiences. These embodied schemas then serve as the basis for all sophisticated acts of cognition and sense-making. Linguistic expressions such as `burning love',`cognitive strain' etc. are examples of how the intertwining of the bodily with the abstract manifests. Such traces are evident even in advanced mathematics discussions where we employ usages like `group is a set of elements',`complex number is an ordered pair' etc.

Summarizing, experiences of `true understanding', `direct grasp' or `true insight' are those wherein deeper cognitive structures like embodied schemas are actively involved and at play. This may be contrasted with learning or engagement that remains more or less in the symbolic or propositional realm (and doesn't go deep), akin to the one shared by the student we discussed at the beginning.

For further discussion on the topic, one may refer to: Sfard, A. (2012). Symbolizing mathematical reality into being—or how mathematical discourse and mathematical objects create each other. In *Symbolizing and communicating in mathematics classrooms* (pp. 37-98). Routledge.

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If undelivered please return to :

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