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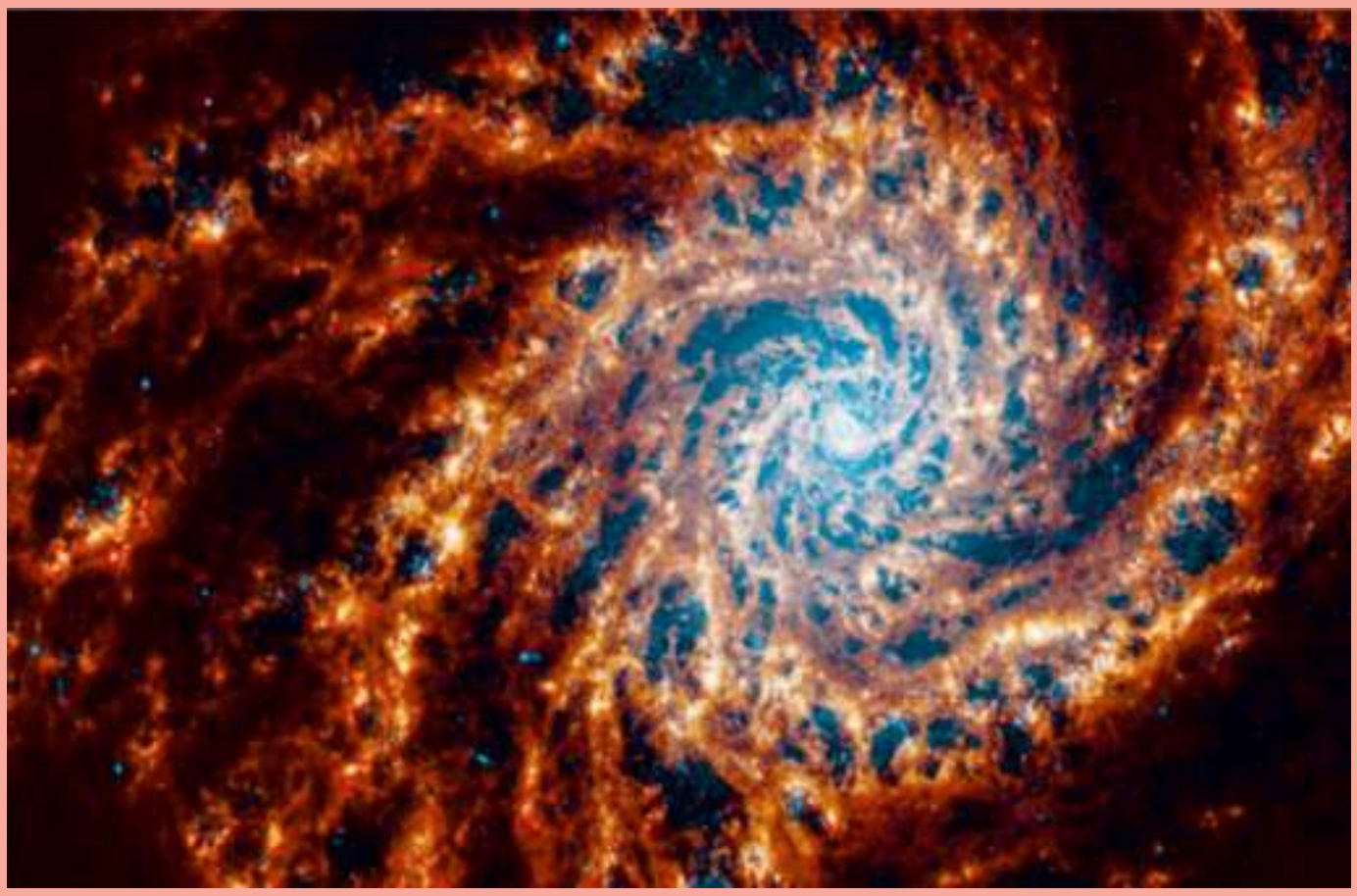

NGC 4254, a spiral galaxy, is resplendent in orange and blue in this Jan. 29, 2024, image from the James Webb Space Telescope. This is one of 19 nearby spiral galaxies recently imaged by the telescope as part of the long-standing Physics at High Angular resolution in Nearby Galaxies (PHANGS) program supported by more than 150 astronomers worldwide.

Webb's Near-Infrared Camera captured millions of stars in these images, which sparkle in blue tones, while the telescope's Mid-Infrared Instrument data highlights glowing dust, showing us where it exists around and between stars.

Link: https://www.nasa.gov/image-article/spiral-galaxy-ngc-4254s-dazzling-swirls/

Bulletin of The Indian Association of Physics Teachers

http://www.indapt.org.in

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

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Editorial

Are we Ready to Ride the Quantum Wave?

April is a very special month, on 14th April, world over world quantum day will be celebrated. This day is celebrated to mark the birth of Quantum Mechanics, date being the first three digits of Planck constant 4.14 (4.14×10^{-15} eV-s) being April 14 as well as birthday of Max Planck. This celebration as WQD started only very recently on April 14, 2022 and this year is the third version of the same. Birth of Quantum Mechanics started a new epoch in the history of physics which opened doors for understanding world of microcosm leading to a deep understanding of the behaviour of particles at the atomic and subatomic level. Chemistry no longer remained mysterious with the cracking of the patterns of periodic table. It led to new technologies in the form of electronic science and technology with the emergence of quantum materials paving way for ubiquitous presence of computers to rule every field of human activity.

After about one and a quarter century it is at the cusp of shaping the future of computing, communication and information science offering new opportunities. Scientists, technologists, academia, economists and politicians are preparing for getting on the bandwagon of quantum revolution 2. We in the physics community are seeing it as a threshold of new possibilities for training young minds to provide quality quantum human resource so that we remain influential players in the body of quantum scientists and technologists.

To ready ourselves to have leadership positions in this race, we as a community of physics teachers must act fast to design quantum courses with in the ambit of physics curriculum starting from the STEM courses in schools to courses at undergraduate and postgraduate level. This can provide talent pathways to the youth in the field of quantum information science removing all the perceived roadblocks by following a focused approach.

IAPT must play a role in it with urgency and foresight through its network spread all over the country. We must take this agenda through our teacher members in the science classrooms in a collaborative manner. Our Regional Councils must show a sense of purpose for this kind of enablement. Starting from awareness programs for students and teacher workshops in quantum science and technologies, IAPT can be a resource generating agency to pave way for rapid change needed to meet the rapidly squeezing timelines otherwise we will miss the bus.

I am happy to note that a sequence of such programs are in the offing starting from celebration of WQD entitled *Alice in Quantum Land*, and countrywide innovative targeted quantum technologies programs. Dedicated groups are working hard. Hats off to their spirit of doing their bit without delay and fuss. Nature loves quantum ways, faster we adopt and adapt to it better will be for us, in the words of Richard Feynman:

> *"Nature isn't classical, dammit, and if you want to make a simulation of nature, you would better make it quantum mechanical."*

PK Ahluwalia

PHYSICS NEWS

Physicists propose new way to search for dark matter: Small-scale solution could be key to solving large-scale mystery

Ever since its discovery, dark matter has remained invisible to scientists despite the launch of multiple ultra-sensitive particle detector experiments around the world over several decades. Most dark matter experiments hunt for galactic dark matter, which rockets into Earth directly from space, but another kind might have been hanging around Earth for years. Dark matter goes into the Earth, bounces around and eventually just gets trapped by the gravitational field of the Earth. Over time, this thermalized dark matter builds up to a higher density than the few loose galactic particles, meaning that it could be more likely to hit a detector. Even when superconductors are cooled to absolute zero, removing all of the energy out of the system and creating a stable quantum state, somehow energy reenters and disrupts the quantum state. What if we actually have a perfectly cold system, and the reason we can't cool it down effectively is that it's constantly being bombarded by dark matter? The next step, Leane and Kurinsky said, is to figure out if and how they can turn sensitive quantum devices into dark matter detectors.

Read more at: https://phys.org/news/2024-03-physicists-dark-small-scale-solution.html

Original paper: Physical Review Letters (2024) DOI: 10.1103/PhysRevLett.132.121801

Scientists on the hunt for evidence of quantum gravity's existence at the South Pole

Several thousand sensors distributed over a square kilometer near the South Pole are tasked with answering one of the large outstanding questions in physics: does quantum gravity exist? The sensors monitor neutrinos arriving at the Earth from outer space. The IceCube Neutrino Observatory is situated next to the Amundsen-Scott South Pole Station in Antarctica. In contrast to most other astronomy and astrophysics facilities, IceCube works the best for observing space at the opposite side of the Earth, meaning the Northern hemisphere. The key question is whether the properties of the neutrino are in fact completely unchanged as it travels over large distances or if tiny changes are notable after all. If the neutrino undergoes the subtle changes that we suspect, this would be the first strong evidence of quantum gravity. Their analysis shows that it is indeed possible, and with future measurements with astrophysical neutrinos, as well as more precise detectors being built in the coming decade, we hope to finally answer this fundamental question

Read more at: https://phys.org/news/2024-03-scientists-evidence-quantum-gravity-south.html

Original paper: Nature Physics (2024) DOI: 10.1038/s41567-024-02436-w

First observation of photons-to-taus in proton–proton collisions

In March 2024, the CMS collaboration announced the observation of two photons creating two tau leptons in proton–proton collisions. It is the first time that this process has been seen in proton–proton collisions. The tau, sometimes called tauon, is a peculiar particle in the family of leptons. Precise research for the tau is rather tricky though, as its lifetime is very short: it remains stable for only $290 \cdot 10^{-15}$ s. The two other charged leptons, the electron and the muon, are rather well studied. A lot is also known about their magnetic moments and their associated anomalous magnetic moments. Although theory and experiments have mostly agreed so far, recent results give rise to a tension that requires further investigation. For the tau, however, the race is still going. It is especially hard to measure its anomalous magnetic moment, a_τ, due to the tau's short lifetime.

This analysis introduces a novel approach to probe tau g-2 and revitalizes measurements that have remained stagnant for more than two decades

Read more at: https://phys.org/news/2024-03-photons-taus-protonproton-collisions.html

Provided By: CERN

Soumya Sarkar
IISER PUNE, INDIA

NCIEP 2023- I Prize
Category: Teacher

ARTICLE

The Beauty of Malus' Law

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Abstract

This experiment aims to provide a comprehensive analysis of polarisation phenomena using Malus law, including linear, circular, and elliptical polarisation, using crossed polarisers. Malus' law provides a mathematical relationship between the intensity of polarised light and the angle between the polarising axis and the incident polarisation direction.

The experiment addresses the experimental methodology for validating the Malus' law. The data collected in the experiments are compared with the theoretical predictions derived from Malus' law, and any deviations or discrepancies are analysed and discussed.

Introduction

History of Polarization

Polarization began with the discovery of polarization of light by reflection. Etienne Louis Malus (1775-1812) a French Engineer discovered the theory of intensity of polarised light. One evening in 1808 he observed the reflection of direct sunlight from windowpane through Island Spar and found two images of the sun.The two refracted lights varied in relative intensities as the crystal was rotated about the line of sight. That led him to formulate a law for the intensity for polarized light.

Part 1

Linearly Polarised Light

When unpolarized light of I_0pass through a polaroid, then half the intensity ($I_0/2$) gets absorbed by the polaroid and another half ($I_0/2$) gets transmitted through the transmission axis of the polariser, and the emergent light is linearly polarised. This is one method of producing Plane polarised light.

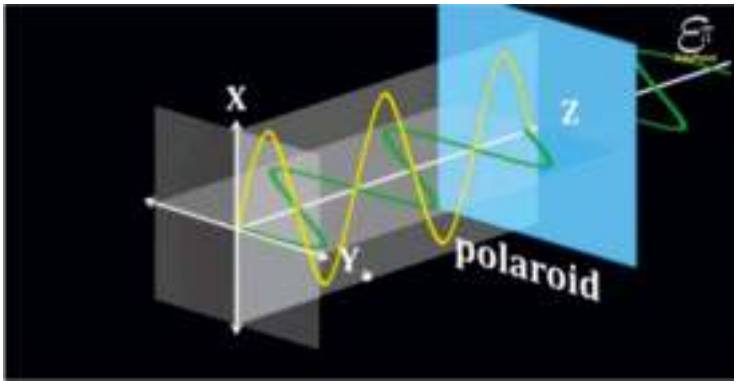

Fig1: The transmission axis of the Polaroid is along the Y axis.Plane Polarised light produced by a*single* Polaroid.

MALUS' LAW

Malus' law states that, "**the intensity of the plane polarised light that passes through an analyser varies as the square of the cosine of the angle between the plane of the polarised light and the transmission axis ofthe analyser**."

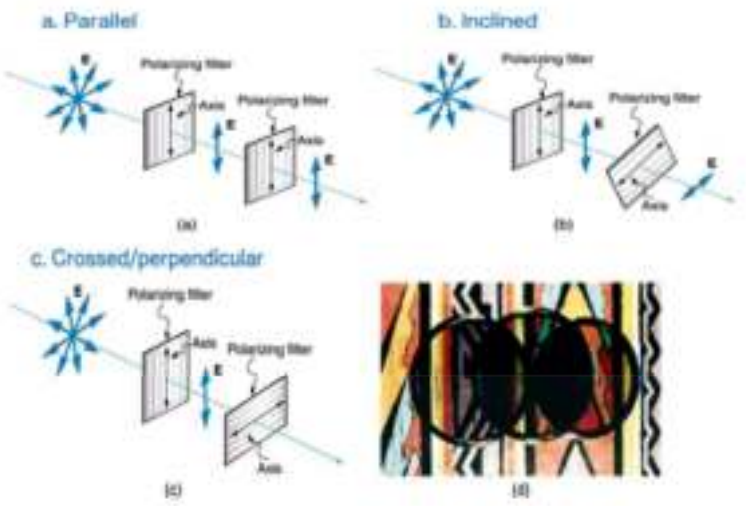

Fig 2: Intensity variation through (a) parallel polaroids – maximum intensity (b) inclined polaroids- decreased intensity and (c) crossed polaroids – no intensity (d) picture in the inset-intensity in the left overlapping region is partial while in the right overlapping region is 'dark'!

INTENSITY MEASUREMENT

Intensity of light is measured using circuit having an LDR and a microammeter in series with a DC supply. Here, the resistance of LDR decreases with increase in intensity of light, then thecurrent in the circuit increases.To obtain the corrected current, the background current (due to extraneous light) is subtracted from the measured current.

EXPERIMENTs

1.Two Polaroids (P_1,P_2)

Fig 3: Laser, polariser, analyser and the LDR are placed coaxial at the same height. The LDR is connected to a DC supply and a milliammeter

Fig 4: A QWP is inserted between the crossed polarizer and the analyser

Formula 1:

I_0 be the initial intensity of the unpolarized light. I_i is the intensity after the i^{th} polaroid.

$I_1 = I_0/2$after polaroid 1 (polarizer)

$I_2 = (I_0/2)\cos^2\Theta$after polaroid 2 (analyser)

Θ is the angle between the two polaroids.

For $\Theta = 0°$, $I_2 = I_0/2$ (maximum, the polariser and analyser are parallel).

$\Theta = 90°$, $I_2 = 0$ (minimum, the polariser and analyser are crossed).

TABLE 1: Polariser (P_1) is fixed, Analyser (P_2) is rotated.

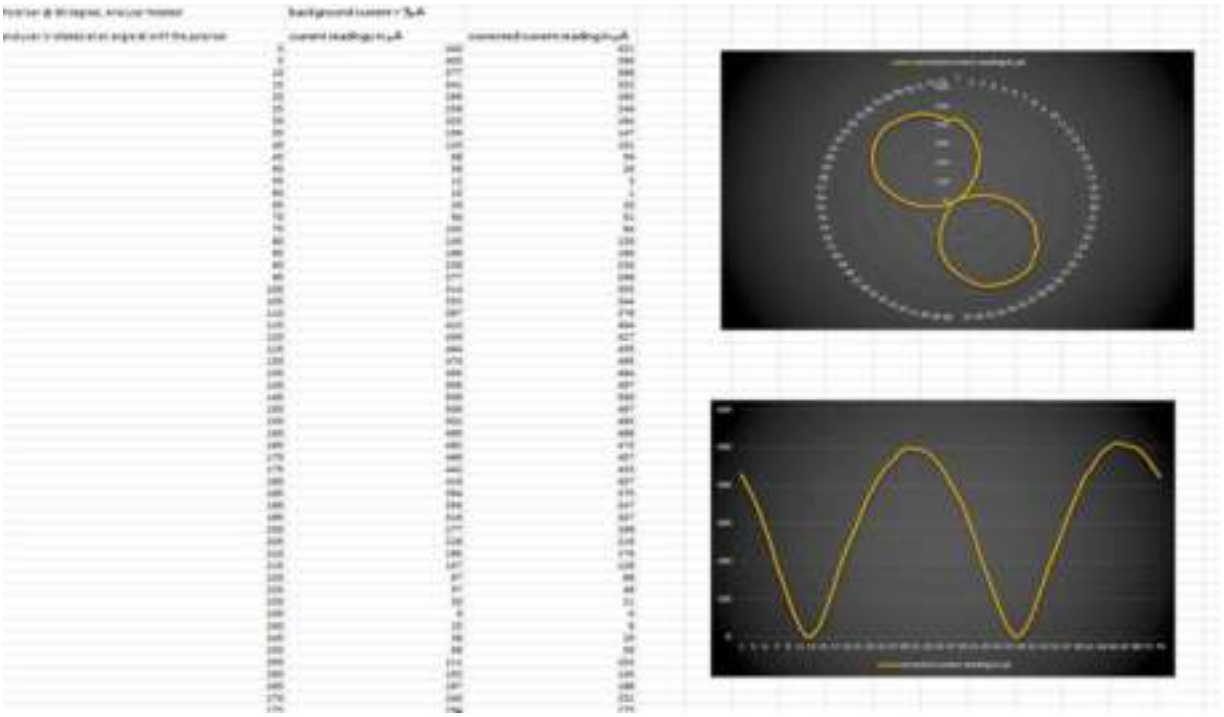

Fig5: (bottom- plot) current versus angle shows **two** maxima and **two** minima(~**zero**) per cycle of rotation.

(top-plot) polar graph exhibits an 'eight' representing a **plane** polarized light.

Result 1: A plane polarised light is detected with a rotating analyser. The intensity of light through the analyser becomes ***zero*** when the transmission axis of analyser is crossed twice with respect to the transmission axis of the polariser(plane of polarization of the light)and maximum twice when the transmission axis of analyser is parallel to the plane of polarization of the light.In the polar graph, the curve of intensity versus the angle of rotation is a '*eight*' 8.

Inference 1:

The electric vector of the incident light is in *one plane* only.Hence,a *plane polarised* light is emerging from the polariser and is incident on the analyser.

2.Three Polaroids P P P **PART 2**

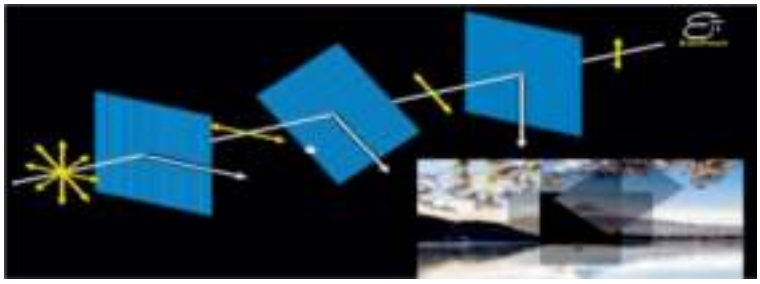

Figure 6: Three Polaroid's are in one line. Initial unpolarised light of intensity I_0 has varying intensity after the successive Polaroid's depending on their orientation with respect to the first Polaroid .

Explanation using Malus'Law.

Formula 2:

$I_1 = \frac{I0}{2}$ $I_2 = \frac{I0}{2}\cos^2\Theta_1$ $\mathbf{I_3 = \frac{I0}{2}\cos^2\Theta_1 \cos^2\Theta_2}$

where Θ_1 is the angle between transmission axes of P_1 and P_2 and Θ_2 is the angle between transmission axis of P_2 and transmission axis of analyser P_n (n= 3).

Special Case:

For P_1 crossed with P_3 and *P_2 removed*,the intensity of light through polariser (P_1) along its transmission axis is $I_1=\frac{I0}{2}$.

After P3,all the intensity gets absorbed by the polaroid and the transmission is zero. Under ideal conditions, 0% is transmitted and 100% is absorbed by the crossed polaroid with respect to I_1.

For P_1 crossed with $P_3$and P_2 inserted between them,some intensity is '*restored*'!

When $\Theta_1 = 45°$ and $\Theta_2 = (90° - \Theta_1)$,

$I_1 = \frac{I0}{2}$

$I_2 = \frac{I0}{2}\cos^2(45) = \frac{I0}{2} \times \frac{1}{2}$

$I_3 = \frac{I0}{2}\cos^2(45)\cos^2(90\text{-}45) = \frac{I0}{2} \times \frac{1}{4}$

Transmission increases to 25% with respect to I_1.

Under ideal conditions, 75% is absorbed by both P_2 and P_3 with respect to I_1.

TABLE 2:

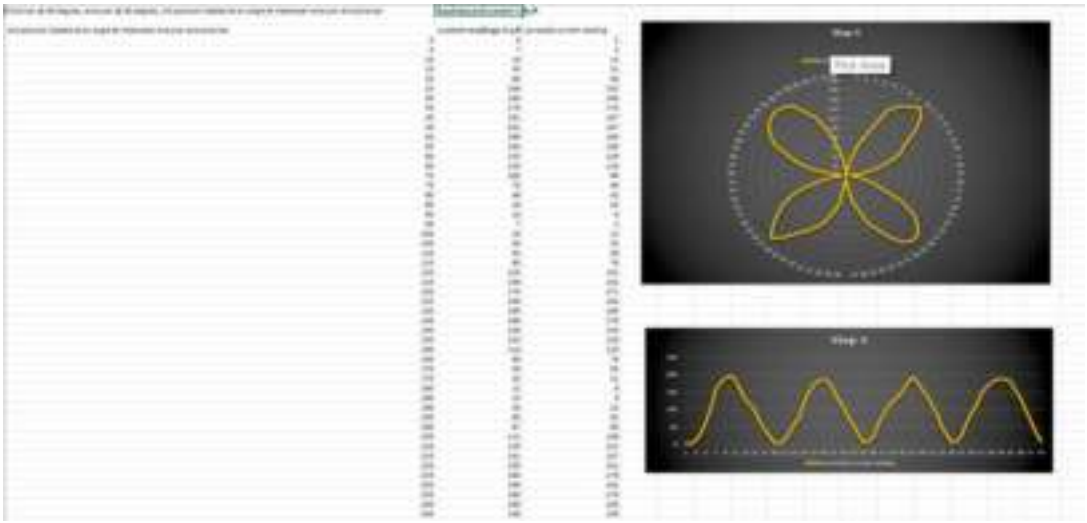

Figure 7.(a)(top-plot) Polar graph shows two 'eights' perpendicular to each other. (b) (bottom-plot)Shows four max and four zeros alternately in one complete rotation of the central polaroid.

Result 2:

When a Polaroid $P_2$is rotated through 360°, in between the crossed polarizerP_1 and analyser P_3 and intensity *varies* across the analyser. There are 4 maxima and 4 minima (zeros)in the intensity versus angle plot.

The polar graph exhibits two '*eights*' perpendicular to each other!

Inference 2:

Two plane polarised light are incident on the analyser with *planes perpendicular* to each other. The electric vectors of the incident light are in two perpendicular planes.

3. More Polaroids

If more polaroids are inserted between polariser and a crossed analyser, what happens?

Using Malus' Law,

(i) with 8 polaroids between the crossed polariser (P_1) and analyser (P_{10})at 10° each, the transmission increases to ~76% while absorption is ~24%by the nine polaroids with respect to the first.

(ii) with 88 polaroids between the crossed polariser(P_1) and analyser (P_{90}) at 1° successively, the transmission increases to a whopping ~97% and absorption is only ~3% by the eighty-nine polaroids with respect to the first.

(iii) If there are infinite number of polaroids between the crossed polariser and analyser, what should be the intensity finally? Guess?

For angle in $\lim_{\theta\to 0}$ *between the successive polaroids, the final intentsity after* P_∞ *should be* 100%

Then transmission becomes 100% again, satisfying**Malus' law**, but the electric vector rotates either clockwise or anticlockwise depending upon the rotation of the transmission axis of all the successive polaroids.

An analogy: we observe that a plane polarised light passing through an optically active materialemerges with full intensity but rotates clockwise or anticlockwise, depending on whether the optical active medium is laevo- or dextro-rotatory! Examples - Sucrose solution, dextrose solution, chiral liquid crystal, etc.

This is the beauty of the Malus' law!

Formula 3:

$\mathbf{I_f = I_1 \cos^2\Theta_1 \cos^2\Theta_2 \ldots\ldots\ldots \cos^2\Theta_\infty}$

Where Θ_1 is the angle between the transmission axes P_1 and P_2,Θ_2 is the angle between the transmission axes P_2 and P_3, and so on.

Result 3:

As the number of Polaroids between the crossed Polaroid increase in number, the intensity of the emergent light increases. And, for infinitely large numbe of polaroids with inclination is in the limit zero, the emergent light has almost 100% light and the plane is rotated clockwise (anticlockwise) depending on the direction of rotation of the transmission axes of the polaroids.

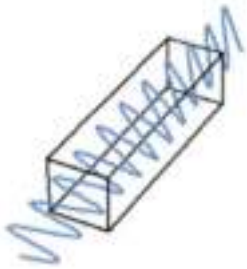

Figure 8: Rotation of the plane of polarization through many polaroids between two crossed polaroids equivalent to optical active media between crossed polaroids.

Inference 3:

The plane of polarization of the linearly polarized light rotates with the rotation of the axes of the transmission of the polaroid and the intensity of the emergent light increases with the number of polaroids**.**

The net effect of *rotation* and *intensity* of the emergent light through infinitely large number of polaroids is like the *optical active* media.

PART 3

States Of Polarisation

- A retarder can change the state of polarisation.
- A wave plate or retarder is an optical device that alters the polarisation state of a light wave travelling through it. Two common types of wave plates are the half-wave plate and quarter-wave plate. Half-wave plate shifts the polarisation direction of linearly polarised light, as the phase difference is π. The quarter-wave plate converts linearly polarised light into elliptically/circularly/ linearly polarised light as the phase difference is π/2.

Formula 4:

The phase difference between the two electric vectors when emerging through a retarder of length L is

$\phi = \frac{2\pi}{\lambda 0} \Delta n\, L$

For a Quarter Wave Plate, the path difference is $\frac{\lambda}{4}$, the phase difference between ordinary ray and extraordinary ray is$\frac{\pi}{2}$.

Formula 5:

The intensity after traveling the QWP and the crossed polaroidsis

$\mathbf{I_f = a^2 \cos^2\alpha + b^2 \sin^2\alpha}$

where Θ is the angle between the electric vector E (or transmission axis of the polarizer) incident on the QWP and its optic axis and α is the angle between the optic axis of the QWP and the transmission axis of theanalyser.And the emergent light is elliptically polarised generally.

a = EcosΘ (amplitude of the electric vector along the optic axis of the QWP = major axis of the ellipse)

b = EsinΘ (amplitude of the electric vector perpendicular to the optic axis of the QWP = minor axis of the ellipse)

Special cases:

a = 1, b = 0 OR

a = 0, b = 1 the emergent light is linearly polarised

a = b,the emergent lightis circularly polarised light

a ≠ bthe emergent light iselliptically polarised light.

a and b depend on Θ.

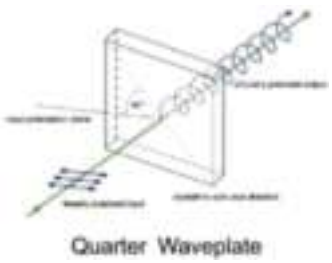

Figure9: when the incident plane polarised light is incident at 45° to the Optic axis of the QWP, the emergent light is circularly polarised.

TABLE 3:

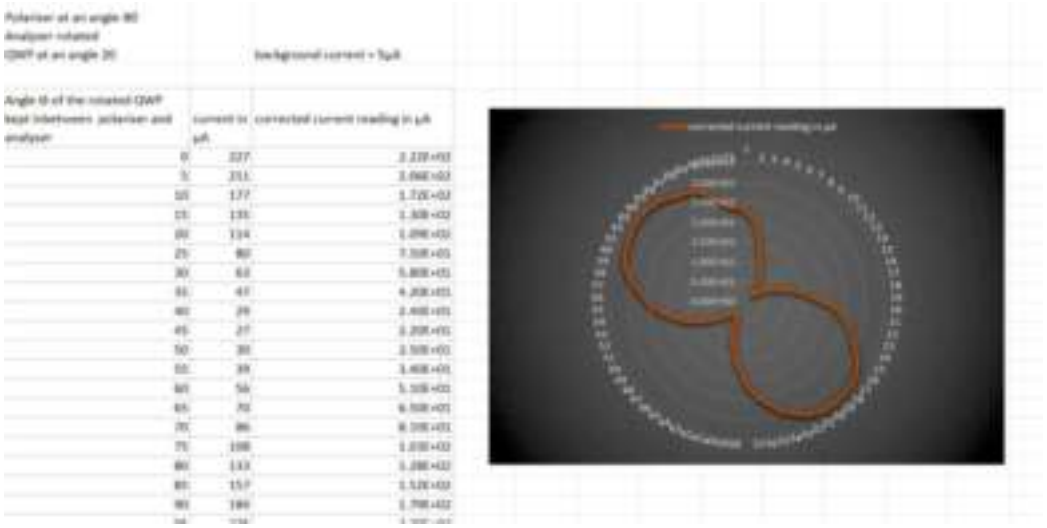

Fig10: QWP rotated to 20°, the plot shows an elliptically polarised light and *a* is the major axis and *b* the minor axis. For one rotation of the analyser, the intensity changes from maxima to a minima (*not* zero),twice.

TABLE 4:

Polariser at an angle-80
Analyser rotated
QWP at an angle 50

background current = 5μA

Angle Θ of the rotated QWP kept inbetween polariser and analyser	current in μA	corrected current reading in μA
0	304	3.00E+02
5	309	3.05E+02
10	284	2.80E+02
15	285	2.81E+02
20	276	2.72E+02
25	256	2.52E+02
30	240	2.36E+02
35	218	2.14E+02
40	193	1.89E+02
45	180	1.76E+02
50	164	1.60E+02
55	153	1.49E+02
60	130	1.32E+02
65	121	1.17E+02
70	109	1.05E+02
75	104	1.00E+02
80	100	9.60E+01
85	102	9.80E+01

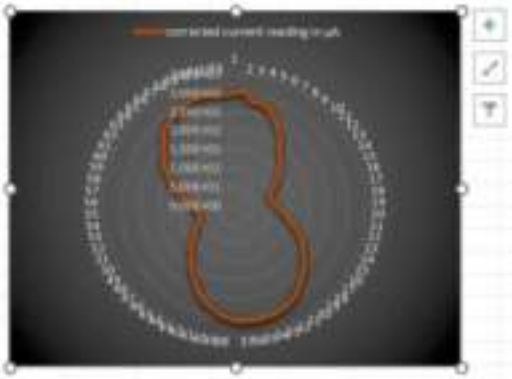

Fig 11: QWP rotated to 50° the plot shows an elliptically polarised light with greater ellipticity.

TABLE 5:

Polariser at an angle-80
Analyser rotated
QWP at an angle 65

background current = 4μA

Angle Θ of the rotated QWP kept inbetween polariser and analyser	current in μA	corrected current reading in μA
0	239	2.35E+02
5	242	2.38E+02
10	242	2.38E+02
15	239	2.35E+02
20	233	2.29E+02
25	226	2.22E+02
30	225	2.21E+02
35	223	2.19E+02
40	220	2.16E+02
45	211	2.07E+02
50	199	1.95E+02
55	201	1.97E+02
60	204	2.00E+02
65	190	1.86E+02
70	196	1.92E+02

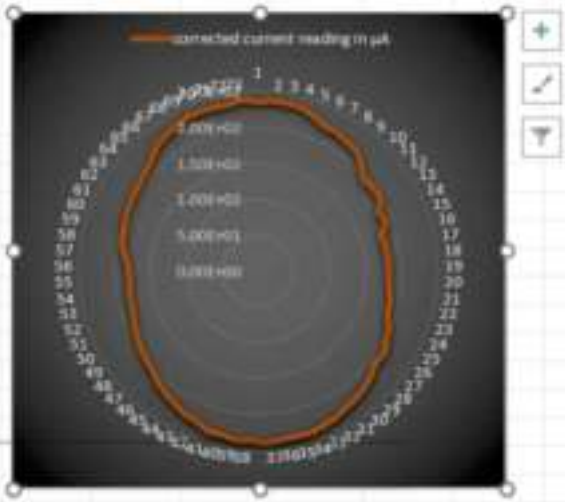

Fig 12: QWP rotated to 65°, the plot shows a nearly circularly polarised light.

TABLE 6:

Polariser at an angle-80
Analyser rotated
QWP at an angle 80

background current = 4μA

Angle Θ of the rotated QWP kept inbetween polariser and analyser	current in μA	corrected current reading in μA
0	172	1.68E+02
5	163	1.59E+02
10	154	1.50E+02
15	148	1.44E+02
20	140	1.36E+02
25	136	1.32E+02
30	138	1.34E+02
35	143	1.39E+02
40	144	1.40E+02
45	154	1.50E+02
50	156	1.52E+02
55	170	1.66E+02
60	184	1.80E+02
65	194	1.90E+02
70	208	2.04E+02
75	220	2.16E+02
80	230	2.26E+02
85	235	2.31E+02
90	243	2.39E+02
95	254	2.50E+02
100	260	2.56E+02
105	266	2.62E+02
110	270	2.66E+02

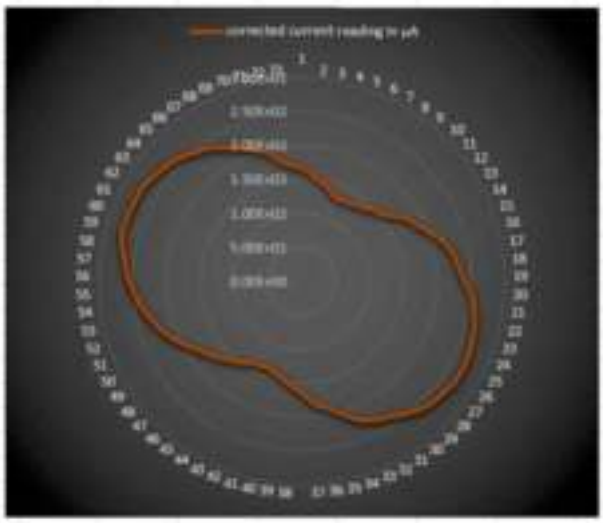

Fig 13: QWP rotated at an angle 80°, the plot shows an elliptically polarised light with a<b.

TABLE 7:

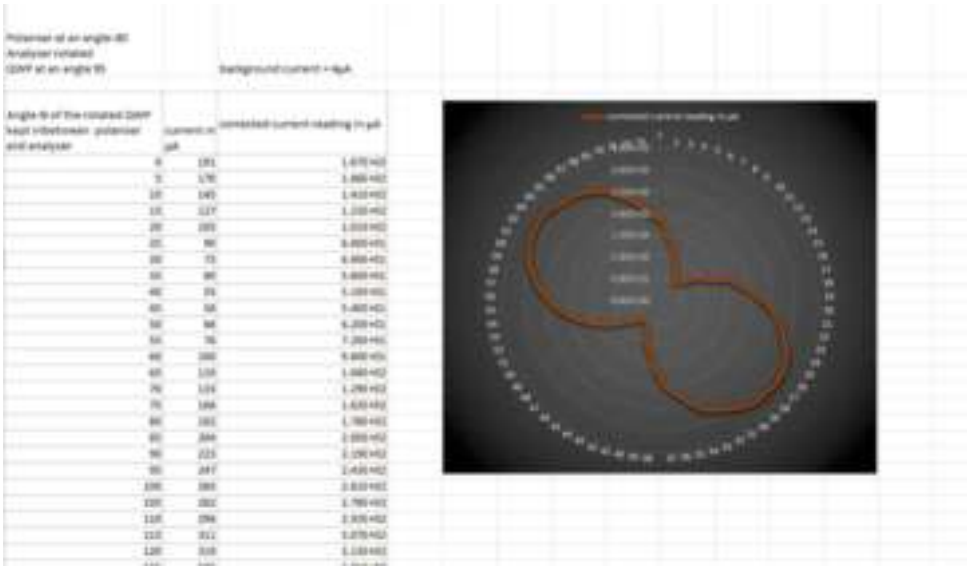

Fig 14: QWP rotated to95°, shows an elliptically light with decreasing *a*.

Result 4:

A retarder introducing a phase difference of π/2 (Quarter Wave Plate) in the plane polarised light produces an elliptically polarised light. The ellipticity gradually increases with the angle Θbetween the plane of polarization and the optic axis of the QWP plate.

For Θ = 0°,90°, 180°, 270°, the emergent light is plane polarised.

For Θ = 45° ,135°, 225°, 315°, the emergent light is circularly polarised.

When Θ increases from 0° to 45°, the major axis decreases, and the minor axis increases.

When Θ increases from 45° to 90°, the major axis increases and the minor axis decreases.

Inference 4:

A QWP in the path of a *plane* polarised light produces *elliptically* polarised light in general. For specific angles, the emergent light is plane polarised or circularly polarised.

Part 4

Quarter Wave Plate Rotated Between Polariser And Analyser

TABLE 8:

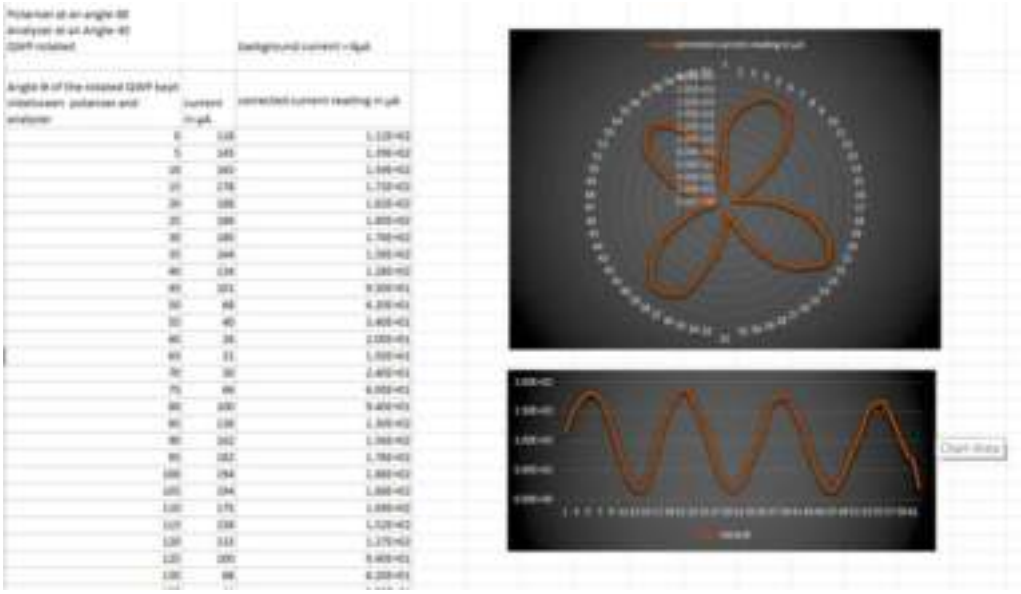

Fig 15: The plot of intensity versus angle shows four maxima and four minima in one rotation. Here the QWP is rotated between the polariser and the analyser.

Comparison of Part 2 And Part 4

Result 5: The final intensity through a quarter wave plate is doubly intense compared to the final intensity through 3 polaroids keeping the position of the lobes at the same angle

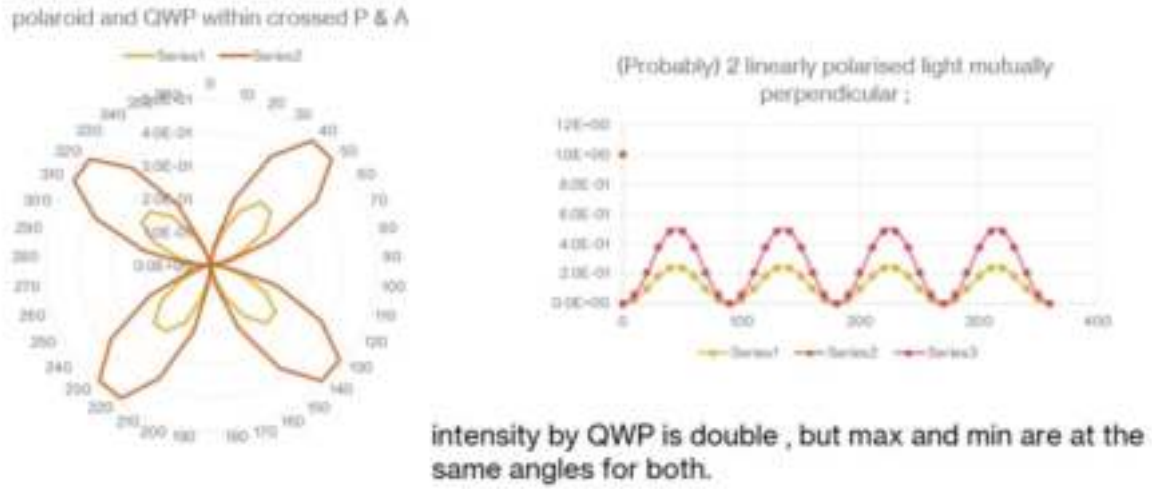

Fig 15: intensity variation due to 3 polaroids and a QWP placed between crossed polaroids are similar, except that the intensity through the QWP is double.

inference5:
Malus's law explains the rotation and the intensity variation of light under all situations. That is the beauty of this entire experiment!

Conclusion: A simple Malus' Law can explain different aspects of Polarization, so well-

- The intensity of a plane polarized light on emerging a Polaroid varies according to the cos square rule-THE MALUS' LAW.
- The intensity variation is a confirmatory test for a plane polarized lightmax-zero-max-zero or the plot of 'eight' in a polar graph.
- The intensity variation differs when the number of Polaroids is increased in the path of a plane polarised light.
- Malus' law also explains the increase of the transmission light with increase of the number of the Polaroids between the crossed Polaroids.
- The rotation of the plane of polarization along with the rotation of the polaroids is implicit in the Malus' Law
- Malus's Law for infinite polaroid explains the rotation and intensity of light through an optically active medium.
- Malus' Law suggests the presence of two plane polarised perpendicular light by max-zero-max-zero-max-zero-max-zero ortwo 'eights' perpendicular to each other.
- Plane polarized Light through a QWP emerges with a phase shift. Malus' Law explains linearly, circularly, and elliptically light.

This is the **BEAUTY** of simple **MALUS' LAW**!

Mysteries of Quantum Entanglement

(Enigmatic Dance of Particles)

D. P. Singh*

Abstract: *Quantum entanglement (QE) is among the most intriguing and perplexing puzzles. It defies our everyday intuitions about the behaviour of particles. In the microscopic realm, particles don't follow the familiar rules of classical physics. Instead, they exist in a probability state. The quantum world allows particles to exist in multiple states simultaneously. QE occurs when the quantum states of these particles become interconnected. Presently, researchers are exploring QE's practical applications, which promise transformative advancements. This article attempts to shed light on the mysteries of QE and its applications.*

Introduction

In the mysterious domain of quantum physics, a phenomenon known as "quantum entanglement" [1] stands out as one of the most intriguing and perplexing puzzles. While it may sound like the stuff of science fiction, quantum entanglement is a natural and fundamental aspect of the quantum world, defying our everyday intuitions about the behaviour of particles. Let's embark on a journey to explore the fascinating world of quantum entanglement, where particles engage in an entangled dance that challenges the boundaries of our understanding.

A Different Reality

At the quantum level, the behaviour of particles like electrons, photons, and atoms is governed by the principles laid out by quantum theory, a branch of physics that describes the behaviours of the very small. In this microscopic realm, particles don't follow the familiar rules of classical physics. Instead, they exist in a probability state, represented by a quantum wavefunction [2]. Notably, the quantum world allows particles to exist in multiple states simultaneously, a phenomenon known as superposition [3].

Entangled Partners

Now, imagine two particles — let's call them Particle A and Particle B — that become entangled. This entanglement occurs when the quantum states of these particles become interconnected so that the state of one particle is directly linked to the state of the other, regardless of the physical distance between them. This link is not like any connection we encounter daily; it's a unique and mysterious bond that transcends space and time. Once particles are entangled, the measurement of one particle's state instantaneously determines the state of the other, even if they are light-years apart. It's as if they are engaged in an intricate dance where each move of one partner corresponds instantaneously to a synchronized move by the other [4].

Albert Einstein famously referred to this instantaneous connection as "spooky action at a distance" in a series of debates with Niels Bohr and other physicists. The idea that information could travel faster than the speed of light seemed counterintuitive and challenged our classical notions of causality [5]. To understand this phenomenon, let's consider the polarization of entangled photons as an example. If we create a pair of entangled photons with opposite polarizations, measuring the polarization of one photon will instantly

determine the polarization of the other, even if they are far apart. This peculiar correlation happens faster than any signal or communication in the classical sense.

Quantum Reality versus Everyday Intuition

The strangeness of quantum entanglement lies in its departure from our everyday experiences and intuitions. In our macroscopic world, we don't encounter objects that can exist in multiple states simultaneously or particles that instantaneously influence each other over vast distances. Quantum mechanics introduces us to a reality that defies our classical expectations, challenging us to expand our understanding of the universe.

It's crucial to emphasize that quantum entanglement doesn't allow for the transmission of information at speeds exceeding the speed of light. While the states of entangled particles are correlated instantaneously, extracting information from this correlation still requires classical communication, ensuring that causality, a fundamental principle in physics, is preserved [4].

Real-World Experiments

Quantum entanglement is not merely a theoretical concept; it has been experimentally confirmed through a series of groundbreaking experiments. One of the pioneering experiments was conducted by physicist Alain Aspect in the 1980s. Aspect's experiments tested Bell's inequalities, which quantify the correlations between entangled particles predicted by quantum mechanics [1].

The results of these experiments defied classical physics predictions, providing strong evidence in favour of quantum entanglement. Subsequent investigations, including those involving entangled particles separated by large distances, known as "cosmic Bell tests," have further supported the non-local nature of entanglement.

In recent years, technological advancements [4] have allowed scientists to entangle particles over unprecedented distances, including experiments involving entangled particles transmitted between a satellite and ground stations on Earth. These experiments showcase the robustness and potential scalability of quantum entanglement.

Quantum Toolbox

While the surreal nature of quantum entanglement may seem far removed from our daily lives, researchers are exploring its practical applications in a burgeoning field known as quantum technologies. Here are some ways in which quantum entanglement could find a place in our technological future:

(i) Quantum Communication:

Quantum entanglement is at the heart of quantum key distribution (QKD), a cryptographic technique that leverages the unique properties of entangled particles to secure communication channels [5]. Quantum communication could offer unprecedented levels of security in transmitting sensitive information.

(ii) Quantum Computing:

Entanglement plays a pivotal role in quantum computing, a revolutionary paradigm that uses the principles of quantum mechanics to perform computations at speeds far beyond the capabilities of classical computers [6]. Quantum computers could revolutionize optimization, cryptography, and drug discovery.

(iii) Quantum Sensing and Imaging:

Quantum sensors, including magnetometers and gyroscopes, benefit from the precision provided by entanglement. Quantum-enhanced imaging techniques, leveraging the non-local correlations of entangled particles, could advance medical imaging and remote sensing [7].

(iv) Quantum Networking:

Creating quantum networks that utilize entanglement for secure long-distance communication is a promising avenue [8]. Quantum networks could form the backbone of a future quantum internet, enabling secure and efficient communication on a global scale.

Conclusion

While quantum entanglement might not impact our daily lives directly at this moment, the ongoing exploration of its applications in quantum technologies holds the promise of transformative advancements. As scientists keep exploring the mysteries of the quantum world, the dance of entangled particles may become a cornerstone of the technological landscape, bringing us innovations that seemed like science fiction just a few decades ago.

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Report (RC-12)

Faculty Development Programme on Materials Characterizations and Hands on Training on Materials Simulation Software (Online mode)

Organized by: Department of Physics, Dayananda Sagar College of Engineering, Bengaluru

Venue: Online mode **Date of the Event:** 26-02-2024 to 28-03 2024

Programme Coordinator: Dr. Meera R Gumaste

Department of Physics, Dayananda Sagar college of Engineering, Bengaluru conducted three days Faculty Development Programme on Materials Characterizations and Hands on Training on Materials Simulation Software from 26th February 2024 to 28th February 2024 through online mode. This FDP was conducted in association with IAPT, Karnataka Regional Council- 12 and Impulse Technology. Gurugram, Haryana.

Dr. C M Joseph , Head, Department of Physics, DSCE was the convener. The FDP was coordinated by Dr. Meera R Gumaste, Assistant professor at Department of Physics, DSCE

Dr. Gopalkrishna Hegde, Professor, CeNSE, IISc, Bengaluru, Dr. M S Jogad Ex Coordinator Dept. of Physics, , Director, CRFM, Jain University (Deemed to be), Bengaluru, Dr. Nilesh Tarwal, Department of Physics, Shivaji University, Kolhapur, Maharashtra were invited as the resource persons for the FDP. Er. Anil Sharma, from Impulse Technology, Gurugram, Haryana was invited to give the hands-on training session on materials simulation using RESCU software.

Prof. M S Jogad, Professor KSAWU Vijayapura, Ex Principal, S. B. College of Science, Kalaburagi, Chairman, Advisor Committee, KSCST, and Professor of Physics (Hon.), SSSUHE, Kalaburagi, EC Member IAPT-Karnataka, RC 12delivered a talk titled Overview of IAPT Activities-Outreach Low-cost Simulation Experiments for UG and PG Courses. Prof Jogad elaborated an overview of the professional body for Physicists, . Prof Jogad also explained how low-cost simulation software can be employed in Physics teaching and research.

Meera R Gumaste

Report (RC-15)

Celebration of the National Science Day 2024

To celebrate National Science Day, RC-15 organized an on line lecture by Dr. Subhash Chander Bera, the Group Director of the Satellite Communication and Navigation Systems Group, Space Applications Centre, ISRO. As associate project director, he was responsible for successfully realizing GSAT-31 and GSAT-24 communication payloads. He started his journey as a student of Physics at the undergraduate level, in Presidency College, Kolkata, but went on to shift his focus to technology by receiving the B. Tech and M.Tech degrees from the Institute of Radio Physics and Electronics of the University of Calcutta. He received his PhD in Microwave and Antenna Engineering from South Gujarat University. Since 1994, he has been with the Space Applications Centre, ISRO, where he has been involved in the design and development of microwave circuits and systems for various INSAT and GSAT series of communication payload projects as well as GAGAN/IRNSS/NavIC payload projects.

DrBera talked about the signal processing work he is involved in. The audience came to know, under his leadership, how the young engineers and scientists in ISRO are developing some very sophisticated equipment for use in satellite communication. The research undertaken by Dr. Bera, or, for that matter, by the scientists in ISRO, is necessity-driven and goal-oriented. Development of indigenous instrumentation is always significant, particularly in space research, as at any point in time, our country may be denied the import of equipment due to the policy change of the concerned government, and it may happen without notice. Moreover, it was revealed that futuristic innovations are very important in a field like space research, and scientists are expected to be aware and alert in this respect and must plan ahead of the emerging needs.

Nearly 100 participants present online could understand the intricacies involved in the tasks undertaken by the ISRO. Dr. Bera underlined that teamwork is the buzzword in ISRO and suggested that younger students make their career plans in ISRO, of course, if they are ready to do hard work, shedding away the concept of a 10 to 5

government job. The speaker answered, quite a few interesting questions, particularly from the younger audience, and the whole exercise was very stimulating.

The online meeting was conducted by Dr C.K Ghosh. Before the beginning of the talk, the RC 15 President, Prof. S. K. Ray, delivered the welcome address, and Dr Bhupati Chakrabarti provided a brief outline of IAPT activities, highlighting the role Prof. D. P. Khandelwal, the founder of IAPT in the last forty years' journey of the organization. Dr Pradipta Panchadhyayee, the Secretary of IAPT RC 15, proposed the vote of thanks.

Bhupati Chakrabarti
Pradipta Panchadhyayee

Report (RC-02)

Celebration of National Science Day

Venue: Lovely Professional University, Phagwara, Punjab

Beneficiaries:750

Inter School and Inter College Competitions were organized by Chemical Engineering & Physical Sciences Department of Lovely Professional University, Phagwara in collaboration with IAPT RC-02 on 28th February,2024. Prof. Lovi Raj Gupta, Pro Vice Chancellor, LPU; Dr Meenakshi Sayal EC member, Central IAPT; Dr Kailash Juglan, Head Physics Department along with Heads of various Science departments of university witnessed the inaugural session. 750 students and 80 faculty members participated enthusiastically in the inaugural session. In the inaugural address, Prof. Gupta inspired the students to live with science. Key note Speaker, Dr. Meenakshi explained the basic principles of electromagnetic induction, floatation, electrification and refraction in very interesting manner through demonstrations. She motivated the students to learn science through real life experiences and asked them to focus on experiential learning.

250 students participated in Rangoli and Science Marathon (Idea Pitching) on the theme: Indigenous Technologies for Viksit Bharat. Judgment was done by Dr Mukesh, Dr Rohit and Dr Gurpreet Singh. In Idea pitching, Bhavya from LPU, Phagwara got first prize, Vaishnavi from Doaba College, Jalandhar got second prize. In Rangoli competition, first and second positions were bagged by Richa Shukla, LPU and Jagriti, CT University respectively. Four teams were short listed for quiz. Team of LPU, Phagwara was the winner and Team of CT University, Ludhiana was the runner up. Dr Geeta Arora was the quiz master. Faculty members of LPU along with IAPT members Dr Rajesh and Dr Neha Munjal enthusiastically managed all arrangements. Prizes and certificates were distributed to the winners. Vote of thanks was presented by Dr Juglan. Enthusiastic response of the students and faculty ensured the success of function.

Meenakshi Sayal
EC Member

Report (RC-06)

Experimental Learning Science for Skill Development

A one Day Student Workshop on "Experimental Learning Science for Skill Development (ELSSD -2024)" was organized by School of Applied Science, Suresh GyanVihar University Jaipur, in collaboration with IAPT- RC-06 on 23 February, 2024. About 100 students and 20 teachers attended the workshop and got benefited from the experience of eminent speakers.

On the day of the workshop, following Resource Persons graced the occasion.

1. Prof. Y. K. Vijay, President - IAPT RC-06 and Director - Centre for Innovation in Science Teaching (CIST), IIS University, Jaipur.
2. Dr. Vipin Kumar Jain, Executive Committee Member, IAPT RC-06 and Associate Professor-Physics & HOD, Chaudhary BansiLal University Bhiwani Haryana.

A gracious floral welcome and a memento were presented to Prof. Y. K. Vijay by the Prof. Gaurav Sharma, Principal, School of Applied Sciences, SGVU Jaipur. Dr. Vipin Kumar Jain was welcomed by Dr. Ankit Kumar Gupta, Convener of workshop by presenting him a flower bouquet and memento.

Prof. Vijay started his presentation by paying tribute to Prof. Babulal Saraf, Indian Physicist and experimentalist who received first prize in the apparatus competition, American Association Physics Teachers in 1979. He threw light on the aims and objectives of IAPT. He captivated the audience and described the fundamentals of Quantum Physics through simple experiments. He explained Vander wall Interaction, Bohr model, Simple harmonic motion, Resonator, Alpha decay, Atom- atom interactions, and Plasma generation at RF frequency through the simple models and experiments in an interesting way.

In the second interactive session, Dr. Jain explained the fundamentals of electronics and optics through self-developed models. He effectively demonstrated some hands on experiment on TIR and Optical fiber, LASER and Diffraction with single slit, double slit, grating, Raman Effect, Interference in water waves; Interference in thin film using glass slides; LASER and Diffraction with Single slit, double slit, grating, CD and DVD and Concept of data storage; Raman effect; TIR and Optical fiber; generation and storage of hydrogen as fuel, etc.

Ankit Kumar Gupta

Report (RC – 22)

Seminar on

Spectroscopy and Machine Learning in Action for a Cleaner Planet

Date: 27-02-202 **Time:** 01:30 pm – 03:30 pm

Venue: Kamala Institute of Science and Technology, Singapur, Karimnagar (TS)

Target Participants: B.Tech. I year students **Organized by**: IAPT (RC-22)

Speaker and Demonstrator: Dr.G.Manoj Kumar, Professor, University of Hyderabad, Hyderabad

The Physics Division of the Department of Humanities and Science, in collaboration with IAPT RC-22, conducted a seminar on "**Spectroscopy and Machine Learning in Action for a Cleaner Planet**" on February 27th, 2024, in the EEE Seminar Hall. **Dr. G. Manoj Kumar**, Professor at the University of Hyderabad, began by explaining what Spectroscopy and Machine Learning tools are and their future prospects. He also explained how these instruments are used to identify plastic waste and organize it by category, which is then recycled to reduce pollution on the planet.The program was attended by approximately 200 1st B. Tech students. The pupils eagerly participated in the seminar. Finally, a question-and-answer session was held to clear up doubts.

V. Rajeshwar Rao

National Competition For Innovative Experiments In Physics (NCIEP) – 2023

National competition for innovative experiments in Physics (NCIEP) is being held since 2003, to encourage Physics Teachers, students and Physics educators to conceive and set up original innovative experiments in Physics. Innovation rather than sophistication is the main theme. The Competition is held every year at the venue of the Annual Convention of IAPT.For the year 2023 it was held at India International School (Deemed to be University), Jaipurduring the 37th convention of IAPT from 8-10thOctober 2023. From this year a new category 'C' was introduced to accommodate High School students.Top 3 experiments from each category A, B and C were awarded cash prizes.

Thirty-four experiments were demonstrated at the competition.

Top ten student participant entries were given an amount of Rs 1000/- each towards expenditure incurred towards setting up the experiment. The first announcement came in the March 2023 bulletin. Subsequently reminders were given in the June, July and August bulletins.

Prof Y K Vijay and his team had made wonderful arrangements for the participants to exhibit their experiments.
Prof P K Dubey, Prof Meenakshi Sayal and Prof V K Gupta were the judges for the teacher's category.
Prof Shivaram Patil and Dr Rashmi M Desai were the judges for the UG and PG student category.
Prof Sapna Sharma and Prof Shyamala Bodhane were the judges for high school student category.
Judges went meticulously through all the experiments

All the experiments were appreciated. Prof P K Ahluwalia, President, IAPT and all the dignitaries present at the convention went through all the experiments.

The following were the prize winners.

Category	First prize	Experiment	Second Prize	Experiment	Third prize	Experiment
A Teachers, Science educators and research scholars	1. Sumana Rao, MES Kishore Kendra, Bengaluru and 2. Sarmishtha Sahu, MLA college, Bengaluru	Beauty of Malus law	Anupama Poti, DAV Public school, Nerul, Mumbai	Equipotential surface	Dr Rajendra kumar B Ahirrao, Uttamrao Patil Arts and Science College, Dahivel	Fabrication of a novel electrochemical reactor
B UG and PG students	Evan Keinz Joy and Raj Joshi, St Xavier's College, Aahmedabad	Measurement of speed of sound waves through diffraction phenomenon	1. Lakshya Nagpal, Dept of Physics, Ramjas College, Delhi 2. Aditya Singh, Dept of Physics, Hansraj College, Delhi	Advancements in opticsbased quantum computing	Kishen Chauhan, Christ college, Vidya Niketan, Saurashtra University	Contactless magnetic gears
'C' High School students	Shreya Anish Arya central school, Tiruvanathapuram	Moving coil galvanometer as an inductor	Rohith Balamukund Sri Kumara n Children home, CBSE, Mallasandra, Bengaluru	Refractive index of water	1.Ananya Varkey, 2.Shriya Kothari , India International School, Jaipur	To measure the number of photons using current through LDR

NCIEP team wishes to thank all the Judges and all the people involved in the smooth conduct of the Event and congratulates all the prize winners and participants.

Geetha R S
Coordinator, NCIEP

Report (IAPT RC- 13)

One day capability building programme for Science Teachers

One day capability building programme for science teachers was organised by the Department of Physics, Dwaraka Doss Goverdhan Doss Vaishnav College in association with IAPT RC-13(TN and Puducherry) on March 5, 2024. 31 Science teachers from various schools in and around Chennai participated in the training.

The programme was inaugurated by Professor T S Natarajan, President RC13 and Dr D Uthra, Secretary RC13 & the head of the department of Physics. Dr V Renganayaki, executive member RC 13, Associate professor, Dept. of Physics and the convener of the event welcomed the gathering. The brief inaugural, set the stage for the forthcoming hands-on sessions.

The morning session was a complete DO IT YOURSELF session, in which the teacher participants performed hands-on experiments. The teachers were split into two member groups. Prof. TSN facilitated the participants to perform the same. He was assisted by Mr. Prem Kumar of KID-START, an IT professional and science enthusiast. Activities that elevate the mood of science learning done with the teachers, viz. What makes the cone roll uphill? What is magnetic levitation, where can you use this concept? How do you visualise conservation of energy? Can you explain physics behind a lazy block? How do you compare and contrast angular momentum and linear momentum? Dr Nirmal Tyagu(Madras Christian College) Dr D Sridevi, Dr D Pourkodee, Dr Selva KothaiNachiyar (D G Vaishnav College) all being members of RC13, joined hands with the convener in facilitating teachers during the training programme. Many similar DIY activities kept the teachers engaged for two complete hours.

The post lunch session was filled with Physics fun and excitement through mind blowing demonstrations by Prof. TSN on the fundamental concepts of Physics. Material Transition involving cryogenic techniques,

moment of inertia concepts, angular momentum conservation, eddy currents, Bernoulli theorem were a few among the concepts shown in demonstrations. Prof.TSN questioned the participants and set the theme of inquiry and self-creation of knowledge.

A feedback session was there to get the essence of Engage, Explore, Explain, Elaborate, and Evaluate from the previous activities with the teachers. The teachers felt extremely happy to get involved in such a training programme. Certificates were distributed to all teacher participants. The entire programme provided a great balance between theory and practical applications of Physics

V. Renganayaki
Convener

Report (RC-08)

Celebration of National Science Day

Activity: Celebration of National Science Day 2024" in collaboration with Marathi Vindhyan Parishad, Dhule Division

Date / Duration: Feb 24 to March 2, 202

Venue: Various schools at Dhule city.

Organized by: IAPT RC 08 in collaboration with MVP Dhule Div.

To celebrate "National Science Day 2024", five popular Science lectures along with two "DVD Shows for Adolescent Boys and Girls" and three "DVD Shows on Science Experiments" were organized for students, teachers and parents in various schools in Dhule city during the last week of Feb. 2024. Dr R. M. Shewale, President, IAPT RC 08 was the resource person for all these programs.

The concluding program and celebration of National Science Day 2024, in presence of school children from various schools and teachers along with their parents was held on Feb. 28, 2024, at Yashwant Vinayan School, Deopur, Dhule. The students demonstrated few experiments on this occasion. Dr R M Shewale delivered a talk on an "Awareness about NSE / NSEJS Examinations and Importance of National Science Day". Prof. M. D. Suryawanshi (HOD Mathematics, SSVPS Science College, Dhule) presided over this function and Chief guest was Principal. C. D. Bhandari (Jai Hind English School, Deopur, Dhule). One teacher coordinator from each school and few parents along with students attended this program. About 1600 students and 100 teachers/parents got benefitted from to this program.

R M Shewale

Report (RC-08E)

Webinar for School Students

Topic: Renaissance man of Indian Science: CV Raman

Invited Speaker: Prof. P.K. Ahluwalia, President, IAPT

On the eve of National Science Day, a captivating webinar titled "Renaissance Man of Indian Science: CV Raman" was organized for the students of RS Mundle School in Samarth Nagar, Nagpur. The webinar, held on 27th February 2024, aimed to enlighten young minds about the remarkable contributions of the legendary physicist, Sir C.V. Raman, in the field of science. The distinguished guest speaker for the event was Prof. PK Ahluwalia, the President of IAPT. Prof. Ahluwalia shared valuable insights into the life and work of CV Raman, highlighting his pioneering research in the field of physics and his significant impact on Indian science.

The webinar was hosted by RC-08E Vidarbha, with Prof. Shamkant Anwane, President of Vidarbha Sub Regional Council, introducing the esteemed guest speaker. Dr. Govinda Lakhotiya served as the host for the event, ensuring its smooth conduct and facilitating an engaging interaction between Prof. Ahluwalia and the audience. Approximately 100 enthusiastic students from RS Mundle School actively participated in the webinar, showing great interest and curiosity as they interacted with the resource person and delved into the life and achievements of CV Raman. The webinar not only celebrated the spirit of National Science Day but also inspired young learners to explore the realms of science and innovation with renewed zeal and passion.

Recording of the lecture can be viewed here: https://youtu.be/y70Ai3RL9Qc

Govinda Lakhoti

Report (RC-15)

Workshop for Orientation of Science Teachers (EBS)

A collaborative effort between Contai Science Academy (CSA), Science Forum, Prabhat Kumar College, and esteemed partners like IAPT Midnapore College Centre for Scientific Culture (CSC), IAPT RC 15, Science Centre, Midnapore, and 'Bring a Smile', the Workshop for Orientation of Science Teachers unfolded on March 19, 2024, at the Seminar Hall of Contai High School. 70 teacher participants from 22 schools, situated in the district of Purba Medinipur, West Bengal, attended the Workshop. This Workshop aimed to address the challenges of contemporary science education in schools, emphasizing the need for activity-based learning and experimentation.

Dr. P. Panchadhyayee, the Secretary of IAPT RC-15, skilfully anchored the seminar, setting the tone for the day's discussions. Mr. Anupam Sau, Headmaster of Contai High School, extended a warm welcome to the participants. Dr. Amit Kumar De and Dr. Gopal Chandra Bera highlighted the existing issues in science education and stressed the teachers' role in promoting activity-based learning. Dr. S. C. Samanta elucidated the background of the Workshop and outlined the one-year project titled "Exhibition on Basic Science (EBS)." He underscored the need to bridge the gap between theoretical learning and practical experience, as emphasized in the NCF

2023. Mr. S. K. Pan, Secretary of Science Centre Midnapore, insisted on the efficacy of activity-based learning methodologies in classrooms.

A significant component of the Workshop was the exhibition of school science experiments, which allowed participants to explore innovative teaching methods. A feedback session was conducted, during which participants expressed their enthusiasm for implementing similar experiments in their schools. Mr. Sanjoy Pal, an activist of CSC, demonstrated various experiments using smartphones, introducing the concept of utilizing smartphones as mini laboratories. Mr Manas Mondal, another activist of CSC, presented an exciting but simple experiment to make people aware of how a simple experiment plays a pivotal role in understanding. Mr. Soumyajit Sahu, Secretary of CSA, presented an excellent demonstration on the importance of real-time feedback during teaching with real examples that he used to employ. This innovative approach garnered interest and showcased the potential of leveraging technology in science education. Dr. Baneswar Das, Assistant Headmaster of Contai High School, shared insightful observations during the valedictory session, reflecting on the program's impact. Mr. Saumitra Sahu, President of CSA, thanked the participants and organizers for the successful event.

In conclusion, the Workshop for Orientation of Science Teachers served as a platform for educators to exchange ideas, explore innovative teaching methodologies, and reaffirm their commitment to enhancing science education at the grassroots level. With a shared vision and collaborative efforts, the seminar paved the way for a transformative journey in science education across schools in Purba Medinipur, West Bengal.

P. Panchadhyayee

Report (RC-02)

Industrial Visit: Transformer making industry

Organizing Departments: Physics

Schedule: 29.02. 2024 10:00 AM onwards

Venue: PP Industry, Industrial Area, Bathinda

Beneficiary: 19 students, 01 Lab Assistant, 02 Teachers

Sponsored: DBT-SCS and IAPT (RC-02)

Activity In-charge: Dr Gurpreet Singh (Associate Professor in Physics & HoD)

Program Coordinator: Dr. Kulwinder Singh Mann

Under the aegis of the DBT-Star College Scheme (San. No. BT/HRD/11/019/2020), the Department of Physics at DAV College Bathinda orchestrated a significant industrial visit to PP-Industry for its 19 undergraduate science students along with two teachers (Dr Gurpreet Singh and Dr K S Mann) and a lab attendant. The ISO 9001:2008 certified PP-Industry boasts state-of-the-art manufacturing facilities and is renowned as a trailblazer in the production of Distribution Transformers, Insulated Wire, and Steel Structures, reshaping India's industrial landscape since its establishment in 1999.

Engineer Mr. Kulvinder Singh of the PP Industry designated as the instructor for the visit, provided invaluable insights into the intricacies of transformer manufacturing, guiding students through key sections of the facility, including primary-secondary wire winding, core building, oil filling, testing, and quality assurance departments. Mr. Singh highlighted the utilization of imported silicon steel from China in core production and addressed pertinent queries regarding theft prevention of copper wire, cost reduction strategies, and the necessity of oil in transformer functionality.

Eager to delve deeper into the practical application of their theoretical knowledge, students seized the opportunity to collect samples of silicon steel for hysteresis loop analysis and transformer oil for refractive index measurement in the physics laboratory. Capturing moments through photography, students demonstrated their enthusiasm for understanding real-world physics applications.

Principal Dr. Rajeev Kr. Sharma lauded the efforts of the physics department in organizing the visit, emphasizing its value in enhancing students' practical understanding. Professors Rakesh Puri, Rajesh Batra, Dr. Shishpal Jindal, and Dr. Vikas Duggal encouraged students to leverage such experiences to their fullest potential, fostering a spirit of curiosity and inquiry.

K S Mann

Report (RC-18)

Celebration of National Science Day 2024

Date: 28th February, 2024

Venue: The ICFAI University Tripura, Kamalghat, West Tripura

Organized by: Faculty of Science and Technology, ICFAI University, Tripura in association with IAPt, RC-18.

The ICFAI University Tripura in collaboration with IAPT, RC-18, organized National Science Day on 28th February, 2024, commemorating the theme for this year's national science day celebration- “Indigenous Technology for Viksit Bharat”. National science day have been celebrated since 1987 in India remarking the invention of Raman Effect to promote science and technology in society. ICFAI University, Tripura is also taking active part in this agenda since its establishment and this day is celebrated by means of various science related activities and competitions involving young minds.

Inaugural session of the National Science Day celebration started by welcoming the Guest of Honor Mr. Ranjit Kumar Debnath, Former Director of School Education; Chief Guest Prof. Pramode Ranjan Bhattacharjee, Retd. Professor and Principal of Kabi Nazrul College, Sonamora; and guest of honor Prof. Anirban Guha, Professor of Department of Physics, Tripura University. Guests were felicitated by offering uttariya, flower bouquet etc. as a token of respect and warmth.

Lightining the lamp ceremony took place symbolizing seeding knowledge in one's mind. Prof. Dr. Biplab Halder (Vice-Chancellor, ICFAI University Tripura), Ranjit kumar Debnath, Prof. Pramode Ranjan Bhattacharjee, Prof. Anirban Guha, Dr. A. Ranganath (Registrar, ICFAI University Tripura) & Prof. Priyangshu Rana Borthakur (Dean, FST, ICFAI University Tripura), took part in this sacred ceremony. Vice-Chancellor Prof. Halder welcomed all the participants and guests and then delivered a highly motivational speech mentioning the history of science day and its importance.

Next speaker was our guest of Honor Ranjit Kumar Debnath. He emphasized on developing scientific temperament, building never give up attitude to get success in life. He has also explained how science and technology has contributed towards development of human society.

Prof. Anirban Guha, Department of Physics, Tripura University talked about the mindset of the worker which plays a significant role in any work. He expressed desire for collaborative work with IUT faculty members and invited students to visit their research laboratories. He asked the students to maintain scientific temperament which will lead us to have a developed society.

The next speaker was Prof. Pramode Ranjan Bhattacharjee. The title of this talk was "Discovery of Ambiquity in the Traditional Norms of Specifying Physical Quantities along the Axes of Coordinates in Drawing Data Based Graphs". In his talk, he has explained about the various anomalies in basic physics which are often ignored in various text books. He discussed about his various research publications in reputed research journals highlighting the discoveries made by him in removing the ambiguous statements found in various basic physics text books.

Two consecutive talks were delivered by Dr. Sovan Ghosh, Associate Professor & HOD Physics; and Dr. Palas Mandal, Assistant Professor, Dept. of Mathematics. Dr. Ghosh delivered a talk on "A History Traced by Cosmology" and Dr. Palas Mandal delivered a talk on "Metamaterials Concept for Mitigation of Earthquake Disaster"

On the spot registrations were done by respective Conveners of the events. Students from nearby schools and colleges participated in various competitive events held throughout the day. The participants were given refreshments.

During this program, several competitions were held in which students from various schools participated. The details of the various events conducted are given below:-

Sl. No.	**Name of the Activity**	**No. of Participants**
1	Sit & Draw Competition	20
2	Model Competition	16
3	Poster competition	10
4	Quiz Competition	28
5	Best out of waste	12
6	PPT presentation	14

The list of students securing the various positions in different activities/competitions conducted is listed below:-

Name of the event	Name of Student	Name of the School/University/College
Sit and Draw (School level)	Ananya Debnath---1st	JNV Mohanpur
	Anwesha Sarkar --- 2nd	JNV Mohanpur
	Sankar Sutradhar --- 3rd	JNV Mohanpur
Sit and Draw (University level)	Sahil Malakar --- 1st	ICFAI UNIVERSITY TRIPURA
	Baisali Debnath --- 2nd	ICFAI UNIVERSITY TRIPURA
	Muskan Roy --- 3rd	ICFAI UNIVERSITY TRIPURA
Science model competition (School level)	Subhrajit Banik, Subhadip Saha ->1st	Umakanta Academy English
	Zinnia Biswas, Utthiti Dhar ->2nd	Sishu Bihar HS School
	Sayantani Roy, Pratyasha Nath-> 3rd	Sri Sri Rabisankar Vidya Mandir
Science model competition (University level)	Rajarshi Majumder, Priyanka Das -> 1st	Bhavan's Tripura B.Ed. College & Tripura University
	Sri Krishna Das, Kohinoor Ak tar -> 2nd	ICFAI University Tripura
	Sagar Rudra Paul, Durjoy Das -> 3rd	ICFAI University Tripura

Name of the event	Name of Student	Name of the School/University/College
Poster Presentation	Rajarshi Majumder, Priyanka Das -> 1st	Bhavan's Tripura B.Ed. College & Tripura University
	Rohan Deb, Jibesh Sinha -> 2nd	ICFAI University Tripura
	Enalisha Sinha, Subham Deb-> 3rd	ICFAI University Tripura
Quiz competition (School level)	Arushi Debbarma, Rinki Roy -> 1st	JNV West Tripura
	Ahamed Farahan, Sumibrata Bhowmik -> 2nd	Umakanta Academy, English med.
	Gourab Dey, Debajit Paul -> 3rd	Umakanta Academy, English med.
Quiz competition (University Level)	Trishnanka Sutradhar, Tapobrata Basu -> 1st	ICFAI University Tripura
	Mahima Debnath, Nikita Baidhya -> 2nd	ICFAI University Tripura
	Soumik Biswas, Saptarshi Ghosh -> 3rd	ICFAI University Tripura
Best out of waste	Baishali Choudhuri->1st	ICFAI University Tripura
	Sneha Roy -> 2nd	ICFAI University Tripura
	Joyasri Datta -> 2nd	ICFAI University Tripura
	Sneha Datta -> 3rd	ICFAI University Tripura
	Sharbari Shome-> 3rd	ICFAI University Tripura
PPT presentation (B.Sc. level)	Subham Saha -> 1st	ICFAI University Tripura
	Niloydeep Das -> 2nd	ICFAI University Tripura
	Sagar Sutradhar -> 3rd	ICFAI University Tripura
PPT presentation (M.Sc. level)	Gourish Chakraborty->1st	ICFAI University Tripura
	Rahul Roy ->1st	ICFAI University Tripura
	Nargis Sultana -> 2nd	ICFAI University Tripura
	Sanjita Baidhya -> 2nd	ICFAI University Tripura
	Prantanu Sarkar -> 3rd	ICFAI University Tripura

As a part of celebration of the day various competitions like Science Model, Quiz, Poster Making, PPT presentation, Sit & Draw, Best out of Waste etc were carried out amongst students from different schools and University. The program ended with prize distribution among the best three winners of each competition. The Umakanta Academy School, Sishu Bihar School and Sri Rabi Shankar Vidyamandir respectively have won the science model competition in school level and Bhavan's & ICFAI at University level. The Sit & Draw competition was won by Jahar Nabodaya Vidyalaya, Mohanpur in school level and the ICFAI in University level. Poster competitions won by Bhavan's and ICFAI. Quiz competitions won by Jaha Naboday Vidyalaya, Mohanpur and Umakanta Academy in school level and ICFAI in University level. The students of ICFAI University Tripura won all three prizes for Best out of Waste and PPT presentation.

Swapan Majumdar

Report (RC-22)

Live Demonstration of models in Physics & Electronics

The Department of **Physics & Electronic**s , St.Ann's college for women , Mehdipatnam, Hyderabad organized a competition on " Live Demonstration of models in Physics & Electronics Fields": The competition was organized in collaboration with IAPT-RC-22 on 29th February,2024 to commemorate National Science day 2024.The institution collaborated with Bhavn'a Vivekananda college of Science, Arts and Commerce to conduct Technovation 2.0 as a National science Day activity. The competition was inaugurated and blessed by Dr. Sr. A.Vijaya Rani, principal, Dr. Daya, the correspondent and Prof. K.Venu Gopal Reddy, from Osmaina University . The principals of St,.Ann's college and Bhavan's college welcomed the Guests. Dr. D. Sarala, Head, Department of Physics , St.Ann's college highlighted the significance of National Science Day and its theme " Indigenous Technologies for viksit Bharath. 30 Students from other colleges of the city presented their working models and the winning teams were distributed First, Second and Third prizes by the judge Prof. Reddy.

First Prize - Smart energy monitoring system

O. Sai Akhil

G. Shruti

Bhavan's Vivekanada College, Secunderabad

V. Rajeshwar Rao

OBITUARY

It is sad to lose a true Physicist and philosopher Mr Vinod Pal Parmar, a life member of IAPT. He left for his heavenly journey on 22nd February 2024. He was born on 19th May 1968 in a remote hamlet named 'Dichali' in the district Uttarkashi in Uttarakhand. It was a remote village that it took hours in reaching the village from the motor head. He took his primary education from the same village and moved to 'Dunda', a block headquarter for secondary education. His association with his native village was such that he named his house in Dehradun as 'Dichali Villa'. He completed undergraduate and post graduate education from Ram Chandra Uniyal Govt PG College, Uttarkashi. It is the place where he was impressed by the vast knowledge of science faculty members such as Prof KL Malgudi, Prof Janardan Joshi, Prof GC Mishra and others. Pursuing PG in Physics under the guidance of Prof Joshi, he developed special interest towards Quantum Mechanics and Solid state Physics, Particle Physics etc. and requested Prof Joshi for providing him the names of some good books in those fields and some more. That time there was no access to good library and internet so he ordered these books form International publishers and developed a library of his own. He would read these books day and night and discussed with faculty members and classmates. This penchant in Physics led him to get admission in M.Phil. Programme in University of Roorkee now named as IIT Roorkee. After completing M.Phil. from Roorkee he chose to follow in the footsteps of his favourite teachers and joined GRD School Dehradun initially and then moved to a renowned Girls residential school Welham Girls in 1996 as a HoD Physics and served till his last breath. His flair for teaching Physics was such that the students who were reluctant to study science developed a knack for it and the number opting for sciences grew leaps and bounds. His great sense of humour and positive persona was instrumental in imparting the basics of Physics to the disciples to the great effect and with full impact. He took his students to NASA trip, CERN trip and many more. He developed pedagogy of quizzing in theory and practical. He was instrumental in organizing light and sound shows during Founders day celebrations in the school. He was a fashion enthusiast and avid badminton player. He was so missed by his students that after his death, they refused to write Physics exam on the stipulated day which was then rescheduled by the school.His ex-students are very successful in life and doing yeoman's service to the society in the form of doctors, journalist, managers, business persons etc. He used to participate actively in IAPT activities and frequently attended meetings, conferences and workshops. His demise is a huge loss to Physics world and IAPT.

Prashant Thapliyal

RC-5

National Gratuate Physics Examination - 2024

National Topper

The following Forty Five Students are shortlisted as the National Top 1% of NGPE - 2024

SR	CENT	ROLL NO		NAME OF THE STUDENT	GENDER	CLASS	INSTITUTE/COLLEGE NAME
1	**G-1111**	**24008**	*	**RITURAJ CHAHAR**	**M**	**B.Sc III**	**ST. STEPHEN'S COLLEGE, DELHI UNIVERSITY, DELHI**
2	G-1111	24017		AARZOO	F	B.Sc III	ST. STEPHEN'S COLLEGE, DELHI UNIVERSITY, DELHI
3	**G-1112**	**24002**	*	**RIYA TEVATIYTA**	**F**	**B.Sc III**	**S. G. T. B. KHALSA COLLEGE, DELHI UNIVERSITY, DELHI**
4	G-1112	24003		RUDRAKSH KAUSHIK	M	B.Sc III	S. G. T. B. KHALSA COLLEGE, DELHI UNIVERSITY, DELHI
5	**G-1112**	**24412**	*	**RISHITA PATHAK**	**F**	**BS/ B.Sc III**	**MIRANDA HOUSE, DELHI UNIVERSITY, DELHI**
6	**G-1112**	**24413**	*	**SHIVANSH TIWARI**	**M**	**BS/ B.Sc III**	**HINDU COLLEGE, DELHI UNIVERSITY, DELHI**
7	**G-1112**	**24418**	*	**ANAND**	**M**	**BS/ B.Sc III**	**BHASKARACHARYA COLLEGE OF APPLIED SCIENCES**
8	**G-1112**	**24426**	*	**DOLLY BANSAL**	**F**	**BS/ B.Sc III**	**ACHARYA NARENDRA DEV COLLEGE, DELHI UNIVERSITY, DELHI**
9	G-1203	24001		RIYA	F	B.Sc III	DYAL SINGH COLLEGE, KARNAL (HR)
10	G-1223	24401	*	KUMKUM	F	INT M.Sc III	CENTRAL UNIVERSITY OF HARYANA, MAHENDERGARH (HR)
11	G-1226	24403		NITISH	M	BS/ B.Sc III	DAYANAND COLLEGE HISAR (HR)
12	**G-2129**	**24413**	*	**SIDHARTH THAKUR**	**M**	**BS/ B.Sc III**	**BANARAS HINDU UNIVERSITY VARANASI (UP)**
13	G-2190	24402		ANURAG SRIVASTAVA	M	BS/ B.Sc III	UNIVERSITY OF LUCKNOW, LUCKNOW (UP)
14	**G-4105**	**24403**	*	**VYAS ASHISH MOKAL**	**M**	**BS/ B.Sc III**	**FERGUSSON COLLEGE (AUTONOMOUS) PUNE (MH)**
15	G-4169	24016	*	TEJAS MAKARAND APTE	M	B.Sc III	MITHIBAI COLLEGE MUMBAI (MH)
16	G-4213	24021		VADGAMA DEVANSHU DILJEET	M	BSMS II	INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH (IISER) PUNE (MS)
17	**G-4213**	**24028**		**YASH DADHWAL**	**M**	**BSMS I**	**INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH (IISER) PUNE (MS)**
18	G-4213	24047		SAPTARSHI PANDEY	M	BSMS III	INDIAN INSTITUTE OF SCIENCE EDUCATION AND RESEARCH (IISER) PUNE (MS)
19	G-5643	24401		MANJAREE	F	BS/ B.Sc II	INDIAN INSTITUTE OF SCIENCE BENGALURU (KA)
20	**G-5643**	**24402**		**DHRUV AALOP SHAH**	**M**	**BS/ B.Sc I**	**INDIAN INSTITUTE OF SCIENCE BENGALURU (KA)**
21	**G-5643**	**24409**		**KANISHK**	**M**	**BS/ B.Sc II**	**INDIAN INSTITUTE OF SCIENCE BENGALURU (KA)**
22	**G-5643**	**24410**		**SRIRAJ CHANDRA**	**M**	**BS/ B.Sc I**	**INDIAN INSTITUTE OF SCIENCE BENGALURU (KA)**
23	**G-7101**	**24412**	*	**MD NURJAMAL SK**	**M**	**BS/ B.Sc III**	**RAMAKRISHNA MISSION RESIDENTIAL COLLEGE (AUTO) NARENDRAPUR, KOLKATA (WB)**
24	**G-7103**	**24002**	*	**SANTANU DUTTA**	**M**	**B.Sc III**	**MIDNAPORE COLLEGE (AUTO) MIDNAPORE (WB)**
25	**G-7103**	**24005**	*	**DEBABNATA DAS**	**M**	**B.Sc III**	**MIDNAPORE COLLEGE (AUTO) MIDNAPORE (WB)**

SR	CENT	ROLL NO		NAME OF THE STUDENT	GENDER	CLASS	INSTITUTE/COLLEGE NAME
26	G-7103	24404		PRANAB HAZRA	M	BS/ B.Sc III	MIDNAPORE COLLEGE (AUTO) MIDNAPORE (WB)
27	G-7110	24001		SRUTI HALDER	F	B.Sc III	LADY BRABOURNE COLLEGE KOLKATA (WB)
28	**G-7110**	**24003**	*	**SOUMILI BANERJEE**	**F**	**B.Sc III**	**LADY BRABOURNE COLLEGE KOLKATA (WB)**
29	**G-7113**	**24003**	*	**SWADESH BHANDARI**	**M**	**B.Sc III**	**RAMA KRISHNA MISSION VIDYAMANDIRA HOWRAH (WB)**
30	**G-7120**	**24402**	*	**RISHAV DE**	**M**	**BS/ B.Sc III**	**SETH ANANDRAM JAIPURIA COLLEGE, KOLKATA (WB)**
31	**G-7129**	**24401**	*	**KOULICK CHAKRABORTY**	**M**	**BS/ B.Sc III**	**BANGABASI MORNING COLLEGE (UNIVERSITY OF CALCUTTA)**
32	**G-7129**	**24407**	*	**PRIYANSHU ROY**	**M**	**BS/ B.Sc III**	**RAMAKRISHNA MISSION VIVEKANANDA CENTENARY COLLEGE RAHARA, KOLKATA (WB)**
33	**G-7129**	**24408**	*	**MANOJIT KAPAT**	**M**	**BS/ B.Sc III**	**RAMAKRISHNA MISSION VIVEKANANDA CENTENARY COLLEGE RAHARA, KOLKATA (WB)**
34	G-7129	24419	*	SOURADIP BHATTACHARJEE	M	BS/ B.Sc III	RAJA PEARYMOHAN COLLEGE HOOGHLY (WB)
35	G-7129	24421	*	PRAGGNYAMITA GHOSH	F	BS/ B.Sc III	RAJA PEARYMOHAN COLLEGE HOOGHLY (WB)
36	**G-7129**	**24428**	*	**SOUMYA DAS**	**M**	**BS/ B.Sc III**	**PRESIDENCY UNIVERSITY, KOLKATA (WB)**
37	**G-7129**	**24436**	*	**SOHAM BHATTACHARYYA**	**M**	**INT M.Sc III**	**INDIAN ASSOCIATION FOR THE CULTIVATION OF SCIENCE, KOLKATA (WB)**
38	G-7129	24450		MEGHNA SANTRA	F	BS/ B.Sc III	ST. XAVIER'S COLLEGE (AUTONOMOUS) KOLKATA (WB)
39	G-7129	24454	*	TAMAL KUNDU	M	BS/ B.Sc III	JADAVPUR UNIVERSITY KOLKATA (WB)
40	G-7129	24455		SWARNAVA BHATTACHARJEE	M	BS/ B.Sc III	RAMAKRISHNA MISSION VIVEKANANDA CENTENARY COLLEGE KOLKATA (WB)
41	**G-7129**	**24458**	*	**RUPSA SINGHA**	**F**	**BS/ B.Sc III**	**ST. XAVIER'S COLLEGE(AUTONOMOUS) KOLKATA (WB)**
42	G-7129	24460		SOURAV PAUL	M	BS/ B.Sc III	RAMAKRISHNA MISSION VIVEKANANDA CENTENARY COLLEGE KOLKATA (WB)
43	G-7129	24461	*	PRATYAN PAUL	M	BS/ B.Sc III	RAMAKRISHNA MISSION VIVEKANANDA CENTENARY COLLEGE KOLKATA (WB)
44	**G-7129**	**24463**	*	**SUPRAKASH SAHOO**	**M**	**BS/ B.Sc III**	**RAMAKRISHNA MISSION VIVEKANANDA CENTENARY COLLEGE KOLKATA (WB)**
45	G-7501	24008		HIMANSHU SEKHAR BEHERA	M	B.Sc III	B. J. B. UNIVERSITY BHUBANESWAR (OD)

The Bold names are the top 25 students eligible for NGPE - 2024 Part C (An Examination in Experimental Skill) while the names with star have been forwarded to S N Bose National Centre for Basic Sciences Kolkata to be considered for direct admission to integrated PhD (only B sc III students). For detailts see: http://bose.res.in/admission.html or write mail to nibedita.konar@bose.res.in OR admission@bose.res.in

The NGPE-2024 Part C will be held on June 22 & 23, 2024 at Inter-University Accelerator Centre, Aruna Asaf Ali Marg, Basant Kunj New Delhi - 110067

Prof B P Tyagi
Chief Coordinator (Examination)

Dr. P K Dubey
Coordinator NGPE

Alternative Conception Studies in PER - Eliciting and Giving Voice to Student Ideas

Consider a typical physics classroom where students are taught, say : a) When two bodies - one heavier than the other- are dropped from the same height, they both reaches the ground at the same time. b) Or when a fast moving heavy bus collides with a scooter, as per Netwon's third law the force on scooter by bus is equal to the force on bus by the scooter. Most students will silently nod their head, write down what is being lectured, and even regurgitate the same when asked. But considering the silence as a sign of real understanding would be a huge mistake on our part! A simple reflection or administration of a conceptual test will reveal that they don't really believe what we teach. They often have more faith in their commonsense conceptions that heavier bodies fall faster or force on scooter by bus is greater than the other way round. Such intuitive, commonsense notions are often tacitly acquired over years of informal interactions with the physical world. Successful application of them in situations encountered in daily life makes them deep rooted and as such they do not yield very easily to formal instruction. These robust conceptions among students, have been studied extensively and are referred to by terms like preconceptions, misconceptions, alternative conceptions etc in PER literature. Starting from the early 80s, there has been studies documenting student conceptions in different topics of physics. Below we provide two classics as illustrative examples of the early work in this regard.

- McCloskey, M. (1983). Intuitive physics. *Scientific American*, *248*(4), 122-131.
- Halloun, I., & Hestenes, D. (1985). Common sense concepts about motion. *American J. of Physics*, *53*(11), 1056-1065.

The subsequent 3 decades saw studies investigating student conceptions in almost all domains of physics - including relatively advanced topics like quantum mechanics and general relativity (for example see papers below). As expected, in advanced topics the difficulties experienced by students are compounded by multiple factors like mathematics, epistemological aspects etc, in addition to the alternative conceptions harbored.

- Singh, C. (2001). Student understanding of quantum mechanics. *American J. of Physics*, *69*(8), 885-895.
- Bandyopadhyay, A., & Kumar, A. (2010). 'Probing students understanding of some conceptual themes in general relativity. *Physical Review Special Topics-Physics Education Research*, *6*(2), 020104.

The important thing about alternative conceptions is that these are not stupid ideas. For effective learning to happen, they have to be elicited, engaged and contrasted with the formal content of physics. To appreciate the reasonableness of student conceptions, ask the first question we started with to an IAS officer with no training in physics. Very likely he will also say that heavier bodies fall faster! Such a conclusion is made after due consideration, often recollecting experiences with falling bodies and then arriving at a generalization. The physics conclusion is the result of a very unfamiliar, artificial thinking process, namely mathematical modeling. We move from the real world to the idealized world of physics, where the body gets represented as a point mass, under the effect of gravity in a vacuum. This mathematical representation is then conjoined with a fundamental law (**F** = m**a)** resulting in a differential equation which when solved gives the counterintuitive conclusion that time taken by a body to reach the ground is independent of its mass !

Implications for Instruction: For learning to be effective, we have to give voice to student reasoning and their prior conceptions. We have to move from a culture of silence prevalent in our classrooms to a culture of discourse. Students should have opportunities to engage in argumentation, to reconcile what they actually think with the formal physics content that they are taught. There has to be explicit instruction about the nature of knowledge construction in physics and how they differ from everyday reasoning. Else the gap between what we teach and what students learn will remain unbridged, leading to poor conceptual understanding and eventual disengagement from physics. In the upcoming issues we will discuss more on operational aspects of incorporating and implementing the above ideas in schools and colleges.

K. K. Mashood

HBCSE - TIFR, Mumbai

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