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What would an erupting volcano on Venus look like? Evidence of currently active volcanoes on Venus was announced earlier this year with the unexplained warmth of regions thought to contain only ancient volcanoes. Although large scale images of Venus have been taken with radar, thick sulfuric acid clouds would inhibit the taking of optical light vistas. Nevertheless, an artist's reconstruction of a Venusian volcano erupting is featured. Volcanoes could play an important role in a life cycle on Venus as they could push chemical foods into the cooler upper atmosphere where hungry microbes might float. Pictured, the plume from an erupting volcano billows upwards, while a vast lava field covers part of the hot and cracked surface of Earth's overheated twin. The possibility of airborne microbial Venusians is certainly exciting, but currently controversial.
https://apod.nasa.gov/apod/ap201027.html

PHYSICS NEWS

Research team pushes back the boundaries of high-energy laser pulses

Using the Advanced Laser Light Source (ALLS) facility, the research team of Professor François Légaré of the Institut national de la recherche scientifique (INRS) has pushed back the boundaries of high-energy pulse propagation in a nonlinear medium through the observation of high-energy multidimensional solitary states. This breakthrough allows the direct generation of extremely short and intense, laser pulses that are highly-stable in time and space. Common laser systems restrict operation to a single transverse mode, which puts an upper limit on laser technology. So far, higher dimensions have been considered detrimental since they are prone to high instability and collapse. This makes the scientific impact of this work remarkable. The observed self-sustained multidimensional wave-packets are driven by picosecond, near-infrared pump pulses in a gas-filled hollow-core fiber, which will be of significant interest to many scientists around the globe. The team believes this idea could push forward laser technology, which has pretty much been locked in one mode for more than 20 years.

Read more at : *https://phys.org/news/2020-11-team-boundaries-high-energy-laser-pulses.html*

Original paper : *Nature Photonics (2020).* DOI: 10.1038/s41566-020-00699-2

Researchers establish proof of principle in superconductor study

Three physicists in the Department of Physics and Astronomy at the University of Tennessee, Knoxville, together with their colleagues from the Southern University of Science and Technology and Sun Yat-sen University in China, have successfully modified a semiconductor to create a superconductor. Using a silicon semiconductor platform—which is the standard for nearly all electronic devices—Professor and Department Head Hanno Weitering and his colleagues used tin to create the superconductor. Superconductors are typically discovered by accident; the development of this novel superconductor is the first example ever of intentionally creating an atomically thin superconductor on a conventional semiconductor template, exploiting the knowledge base of high-temperature superconductivity in doped 'Mott insulating' copper oxide materials.

Read more at : *https://phys.org/news/2020-11-proof-principle-superconductor.html*

Original paper: *Physical Review Letters (2020).* DOI: 10.1103/PhysRevLett.125.117001

Sensor experts invent super cool mini thermometer

Researchers at the National Institute of Standards and Technology (NIST) have invented a miniature thermometer with big potential applications such as monitoring the temperature of processor chips in superconductor-based quantum computers, which must stay cold to work properly. NIST's superconducting thermometer measures temperatures below 1 Kelvin (minus 272.15 °C or minus 457.87 °F), down to 50 milliKelvin (mK) and potentially 5 mK. It is smaller, faster and more convenient than conventional cryogenic thermometers for chip-scale devices and could be mass produced. NIST researchers describe the design and operation in a new journal paper. Just 2.5 by 1.15 millimeters in size, the new thermometer can be embedded in or stuck to another cryogenic microwave device to measure its temperature when mounted on a chip. The researchers used the thermometer to demonstrate fast, accurate measurements of the heating of a superconducting microwave amplifier.

Read more at : https://phys.org/news/2020-11-sensor-experts-supercool-mini-thermometer.html

Original paper: *Applied Physics Letters (2020).* DOI: 10.1063/5.0029351

Searching for axion dark matter conversion signals in the magnetic fields around neutron stars

According to theoretical predictions, axion dark matter could be converted into radio frequency electromagnetic radiation when it approaches the strong magnetic fields that surround neutron stars. This radio signature, which would be characterized by an ultranarrow spectral peak at a frequency that depends on the mass of the axion dark matter particle in question, could be detected using high-precision astronomical instruments. Researchers have recently carried out a search for traces of this axion dark matter conversion in data collected by two powerful telescopes, the Green Bank Telescope (GBT) and the Effelsberg Telescope.

Read more at : *https://phys.org/news/2020-11-axion-dark-conversion-magnetic-fields.html*

Original paper: *Physical Review Letters (2020).* DOI: 10.1103/PhysRevLett.125.171301

Sandeep Kaur
Department of Physics
Panjab University, Chandigarh

BULLETIN OF INDIAN ASSOCIATION OF PHYSICS TEACHERS (ISSN 2277-8950)

Announcement

In view of the continuing COVID-19 pandemic crisis in our country, the **35th Annual IAPT Convention** planned to be organized at Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore during February 2021,

HAS BEEN POSTPONED TILL FURTHER NOTICE.

K N Joshipura
General Secretary

Guidelines for the contributors

The IAPT Bulletin recommends for publication:

- Articles, reviews and short notes on subject matter related to physics content and physics teaching at secondary, undergraduate and postgraduate levels. The write-up must offer some new insight into the topic under discussion. Mere reproduction of information available on the internet be avoided.
- Letters and comments on matter published in the Bulletin.
- Reports, news and announcements about important physics related IAPT activities/events in the country.

Articles, reviews and short notes

- Research papers in specialised fields of mainstream physics may not be sent. Research journals catering to specific areas of physics already exist. However, reviews of recent developments in various fields are welcome.
- All the matter should be sent by email to iapt@pu.ac.in. Acknowledgement via email will normally be sent within 10 days. Submissions received via post without soft copy may be considered provisionally, but if accepted for publication then soft copy must be provided. Authors should retain a copy of their write-up, rejected articles will not be sent back. Contributors should give their contact number as well.
- The length of the write-up should not, ordinarily, exceed 6 pages of the Bulletin, including diagrams, photographs, tables, etc.
- All matter received for publication is subject to refereeing. The editors reserve the right to abridge/alter the write-up for the sake of clarity and brevity.

IAPT activity reports

The report must contain the following:

- Name of the activity
- Date/duration
- Venue of the activity
- Organising institute along with collaborators, if any
- Sponsors, if any (IAPT, RC or any other funding agency)
- Summary of the activity
- Name of the coordinator/convener/organiser along with address, email and mobile number

Maximum two photographs, if available, may be sent separately via email, preferably of the activity or audience.

Please send the report soon after the activity is over, not later than, say, three months.

If you are sending reports of more than one activities for publication in one issue of the Bulletin, kindly send a consolidated report of all the activities in a single communication.

RELAXATION TO EQUILIBRIUM STATE

D. Syam[1,2]

1) Kalpana Chawla Centre for Space and Nanosciences, 26/H/12 R. M. Dutta Garden Lane, Kolkata – 700010
2) Guest Faculty, CAPSS, Bose Institute, Salt Lake, Kolkata – 700091
syam.debapriyo@gmail.com

Abstract: *Relaxation is a process through which a system returns to its equilibrium state in a monotonic way. Such a manner of evolution is witnessed in many branches of Physics when a system tends to reach a stable (non-oscillatory) state. In this article we shall discuss some examples of the relaxation phenomenon. These examples are drawn from a wide variety of fields and can be easily studied in an undergraduate laboratory.*

Introduction

Relaxation is a process whereby a system, which has been displaced from its equilibrium state, returns to that equilibrium state in a non-oscillatory manner i.e. like an over-damped oscillator. Common examples include the motion of the suspended coil of a dead-beat galvanometer and the cooling, following Newton's celebrated law, of a hot object left to itself in an open environment.

In many cases, if fe be the value of a property of a system at equilibrium and f its instantaneous value then the approach to equilibrium, when it is left to itself, is governed by the equation

$$\frac{df}{dt} = -\frac{f - f_e}{\tau} \qquad ...(1)$$

where t is a characteristic interval of time, known as the **relaxation time.**

The solution of this equation is

$$f = (f_{(t=0)} - f_e)e^{-t/\tau} + f_e \qquad ...(2)$$

In this article we shall explore a few examples of the relaxation process. The experimental arrangements to study the phenomena can be readily set up in an undergraduate laboratory.

1. **The first example we consider is the return to original shape and size of a compressed 'bun' (usually a squat cylindrical piece of loaf).** Typically, the process takes about 10 sec.

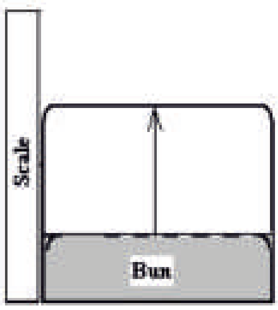


Fig. 1

The bun is compressed and then released. It is possible to follow the evolution by noting time with a watch and measuring the thickness of the bun with a 6-inch scale placed vertically beside

the bun. But a better option is to record a video of the process with a smart phone and perform the analysis later.

Here, thickness (h) stands for the function f and, if the thickness changes in accordance with eq.(1), then one may expect t~ 5 sec. The thickness of the bun in the uncompressed

condition is he.[Actually, unless the compression is by a small amount, the bun does not regain its full height but stops a little short of that; and, generally, the final shape becomes slightly different from the original. The distortion increases as the process is repeated.]

2. **Motion of a light ball, attached to a thin and narrow strip of plastic, through a viscous liquid.**

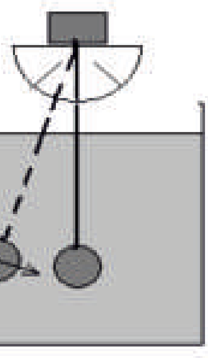


Fig. 2

(a) For the circuit given in Fig. 5a, first the battery with e.m.f. E is connected to the series combination of L and R. After some time, when the current through R is I_0 (voltage across R is V_0=RI_0), the battery is disconnected and the current is allowed to flow through a bypass path. If this change is enacted at time t = 0, the subsequent variation of voltage across R is given by

$$V = V_0 e^{-\mathrm{R}t/\mathrm{L}} \qquad \ldots(6)$$

Suitable values of L and R: L ~ 2H, R ~ 1 (2 – 5 W). [Three 1Ω/2W resistors connected in parallel results in L / R ~ 6 sec, which makes the variation given by (6) easier to follow.]

(b) Consider next the circuit given in Fig. 5b. After charging up the capacitor C to a voltage V_0, by using the battery, the two-way key is connected to the bypass path. The capacitor now discharges through R. If the switch-over is made at time t = 0, the voltage across the capacitor at any later time (t) is given by

$$V = V_0 e^{-t/\mathrm{CR}} \qquad \ldots(7)$$

Suitable values of C and R: C ~ 10 F, R ~ 100 k.

A digital multimeter (DMM) should be used in both the experiments. One may also use a Smartphone (in Video recording mode) to record the changes in the meter readings with time.

6. **Precipitation of particles suspended in water.**

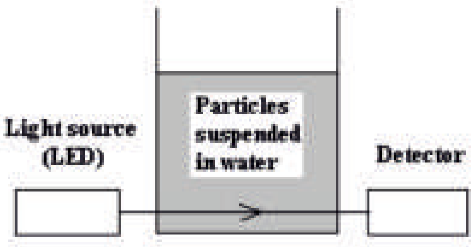


Fig 6

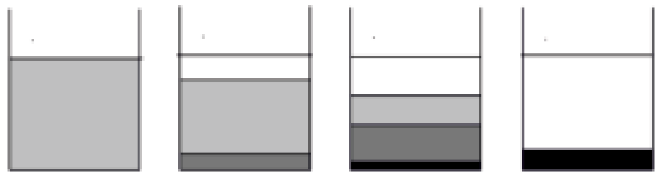


Fig 7

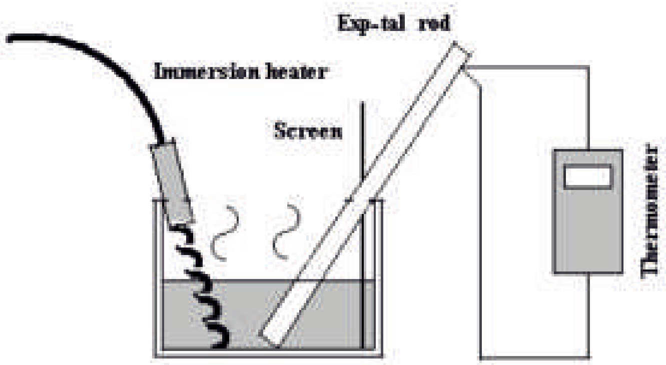
Put 15 - 20 grams of small (diameter 0.5 mm), more or less round, water-insoluble particles like poppy seeds in a transparent container. The pile of particles should have a height of about 1.5 cm.

Place a light emitting diode (LED) at a height that is slightly less than the height of the column of particles. Next set up, as shown in Fig. 6, a phototransistor (PT) at the same height as the diode and construct both the LED and the PT circuits. [Instead of PT, one may also use a light-dependent-resistor (LDR) for measuring the intensity of light. The LDR needs prior calibration].

Pour water into the container till the height of the water column is about 10 cm. Now stir the water vigorously in a haphazard fashion so as to produce (roughly) a uniform suspension.

Turn on the LED and the PT circuits and note down the PT current as a function of time. As the particles start to precipitate, the density of particles increases near the bottom end of the container and the amount of light reaching the PT decreases. (See the sequence of figures from left to right in Fig. 7. Deeper shades represent higher concentrations of particles). There will be a corresponding decrease in the photocurrent. **Question: How does the PT current vary with time? Does it decay exponentially?**

7. **Approach towards a steady temperature.** ***(This is, strictly speaking, not exactly a relaxation phenomenon.)***



kept in a reservoir. Boiling is sustained with the help of an immersion heater. A screen prevents water vapour from reaching the other end of the rod.

With the passage of time the temperature of the free end of the rod approaches a steady value. If, in the Celsius scale, θ_0 be the ambient temperature and $\theta(t)$ the temperature of the free end at time t (measured from the instant when the rod was dipped in the boiling water), then it follows from Fourier's equation for conduction of heat that

$$\theta(t) - \theta_0 \sim (100 - \theta_0) e^{-\alpha L}(1 - e^{-\beta t}) \qquad \ldots(8)$$

The constants,   are related to thermal conductivity and thermal diffusivity of the material of the rod and, also, the rate of loss of thermal energy to the surroundings (in accordance with Newton's law of cooling). The exact nature of the variation of

Here is an instance of overdamped oscillation. The equation of motion of the ball is roughly given by

$$\frac{d^2\theta}{dt^2}+k\frac{d\theta}{dt}+\omega_0^2\theta=0 \qquad ...(3)$$

In eq. (3),   is angular deflection, while k and ω_0 are related, respectively, to viscosity and the restoring force. The solution in the overdamped situation ($k>2\omega_0$) is

$$\theta=(C\cosh\sqrt{k^2-4\omega_0^2}.t+D\sinh\sqrt{k^2-4\omega_0^2}.t)e^{-kt}$$

Putting in the initial conditions: $\theta=\theta_0\, d\theta/dt=0$, we have

$$C=\theta_0,\quad D=\frac{k\theta_0}{\sqrt{k^2-4\omega_0^2}}$$

If k is comparable to $2\omega_0$ $\quad \theta\approx\theta_0 e^{-kt}$

The motion of the ball can be analyzed by keeping a record of time (t) versus, or better still, by recording a video of the motion. By changing the length, width or the thickness of the plastic strip, the transition from overdamped to underdamped motion can be studied. A similar kind of study can be undertaken by hanging the ball with the help of a polyester fibre.

3. **Ringing of a metal bowl**

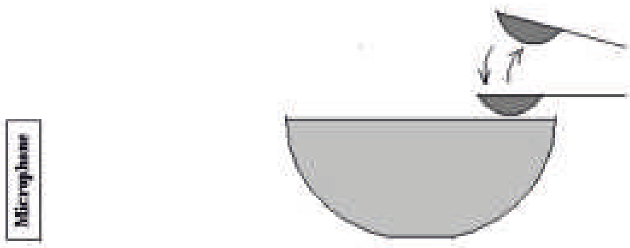


Fig. 3

A metal bowl can be set ringing by striking it with a metal spoon. The amplitude of vibration of any point of the bowl decreases with time exponentially with a time constant

which we shall represent by. Consequently, the intensity of the sound received at any location also decreases exponentially. Note that the perceived intensity I is the average value of intensity over many cycles of oscillations. If ω be the frequency of the fundamental mode of vibration and T the corresponding time period, the average value may be evaluated over n cycles of oscillations such that tñññnTññT. Thus, we may write

$$I(t+nT/2)\sim A^2\cdot\frac{1}{nT}\cdot\int_t^{t+nT}\sin^2\omega t'\cdot e^{-2t'/\tau}\cdot dt'\sim A^2\cdot\frac{e^{-2(t+nT/2)/\tau}}{2}$$

Hence $\qquad I\approx I_0 e^{-2t/\tau} \qquad ...(5)$

The intensity of the sound reaching a point can be recorded with a microphone and later analyzed with the help of suitable software or by using a digital storage oscilloscope. Interested readers may check out the Apps 'Sound Meter' and 'Sound Analyzer Free'.

4. **The variation of the depth of a vortex with time.**

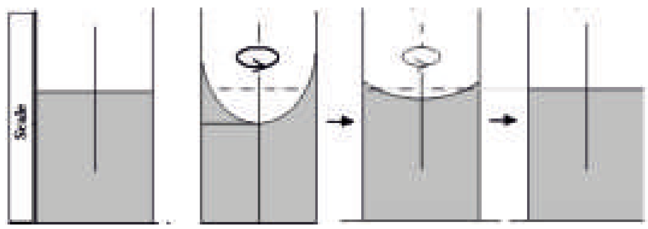


Fig 4

Water is taken in a transparent container having axial symmetry. It is given a vigorous

rotational motion with the help of a spoon. **The surface of water takes a nearly paraboloidal shape** (see: A. K. Raychaudhuri - Classical Mechanics, Ch 30).

With the passage of time, the angular velocity of the rotating mass decreases (due to viscosity) and the depth of the vertex, below the surface level of undisturbed water, gradually becomes less. The dynamics is complicated, but it is not difficult to prepare a table of depth (measured with the help of a scale) against time. Once again, a smart phone may be used very effectively to record and analyze the evolution of depth with time. **Question: Does depth vary with time in accordance with eq. (1)?**

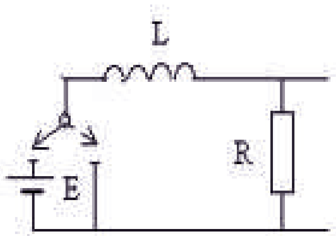


Fig. 5a

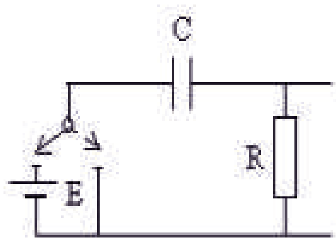
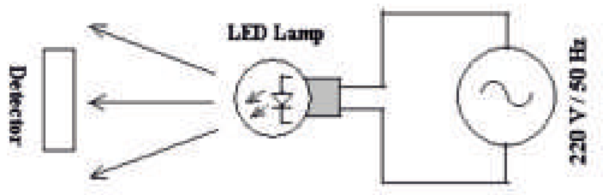


Fig. 5b

(t) can be found by applying the method of Laplace or Fourier transforms.
Temperature can be measured with a thermocouple or an RTD probe.

8. **Variation of the intensity of light emitted by a LED lamp after switching off the power supply**



ut AC voltage into a DC voltage suitable for operating the bank of LEDs. When the AC mains supply is switched off, the capacitor in the filter part of the rectifier unit (which is used to stabilize the DC voltage) discharges through the LEDs producing an 'afterglow' for some time. **The time-variation of the intensity of the afterglow is expected to be exponential in nature**. This can be checked with a PT or a LDR; a DMM would be required in either case, if video recording of the output voltage is carried out. Alternatively, a Digital Storage Oscilloscope may be deployed for measurement, or a video recording of the value of the intensity of light, as displayed by a luxmeter (when such a device is available) can be made. If a smartphone is equipped with a light sensor (enabling a measurement of the intensity of light) then the recording and analysis may be directly carried out with it using the App LUXMETER downloadable from waldau-webdesign.de.

Conclusion:

In this article we have suggested several experiments that feature relaxation phenomena in different contexts (mechanical, acoustic, optical, electrical circuits). These are mostly low-cost experiments and they can be set up in any undergraduate laboratory. For data analysis in some cases, a laptop or a desktop computer can be used to great advantage.

Acknowledgment:

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Flat No. 206, Adarsh Complex,
Awas Vikas-1 Keshavpuram, \
Kalyanpur, Kanpur-208017
Email : iaptknp@rediffmail.com
Mob. : 09935432990

Article

IN FOCUS: NON-EXISTENCE OF SECOND ORDER PHASE TRANSITIONS - WORKS OF YURI MNYUKH

N. V. Chandra Shekar, Awadhesh Mani and R. Baskaran

Indira Gandhi Centre For Atomic Research, Kalpakkam 603102, Tamil Nadu

email: chandru@igcar.gov.in

Abstract

Indram mitram varuNam agnim ãhuh, atho divyah sa suparNo garutmãn,

ekam sad viprãh bahudhã vadanti, agnim yamam mãtarišvãnam ãhuh.

The Existent is One, but the sages express it variously; they say Indra, Varuna, Mitra, Agni; they call It Agni, Yama, Matarishwan (translation: Sri Aurobindo)

Rig Veda (1.164.46)

This report traces the history of classification of phase transitions in material briefly and then focused on the works of Yuri Mnyukh, who has published a series of papers wherein he discusses fundamental aspects of the Ehrenfest scheme to put forth his arguments for establishing that "second order phase transitions cannot materialize and hence do not exist". He examines the Ehrenfest Scheme from two critical angles (i) look at the possible mechanism of transition in first and second order transitions and (ii) look for clear signatures of characteristics of a second order transition. Examples are provided from the literature published by Mnyukh et al., wherein he puts forth the essential result that rules out the very existence of the second order phase transitions.

Beginnings-study of different phases and phase transitions: As we look around us we become immediately aware of different phases of matter. Researchers are curious about the peculiar properties of different phases and constantly trying to find out if any of these properties could be made use of by us for improving our standard of life. Not only there exist different phases of matter, but they do transform from one phase to another under variety of conditions. We are also interested in these transformations and understanding them with two objectives (i) to understand the mechanism of transformation and get insight into the underlying physics and (ii) to use this scheme and design materials with improved useful properties. The most well-known and popular example is that of transformation in water as a function of increasing temperature from solid to liquid to gas. With an addition of another thermodynamic variable-pressure the phase diagram becomes very complex for a molecular material as simple as water.

Cagniard and Andrews: Historically the study of phase transformation can be traced back to 1822 when Charles Cagniard de la Tour studied the transitions in alcohol and characterized the transition between liquid and gas phases by temperature, pressure and volume (see box item 1). Subsequently it was Thomas Andrews in 1863, worked with a large number of liquids and experimentally studied them (see box item 1). He has coined the term "critical point" while referring to the point at which transformation takes place. The credit of coming out with a phase diagram, in the year 1873– a graph showing different regions of phases characterized by distinct temperature and pressure belongs to Josiah Willard Gibbs (see box item 1). In magnetic materials the location of the critical point wherein the ferromagnetism disappears was derived theoretically by using Weiss's theory of ferromagnetism (1907) and critical point was named as "Curie point" by Weiss and Heike Kammerlingh Onnes in 1910.

Onnes and Keesom: The stage was set for the introduction of a set of rules for "Classification of phase transformations" as broad range of systems was being studied in detail. In the year 1908, Kamerlingh Onnes liquefied helium and thereby made University of Leiden a great Centre of research in physics at low temperatures (see box item 2) [1]. Melting and boiling which is nothing but phase transformations from solid to liquid and liquid to gas (vaporization). The phase changes are characterized by the concept of enthalpy of condensation or enthalpy of vaporization. The **enthalpy of condensation** (or heat of condensation) is by definition equal to the **enthalpy of vaporization** with the opposite sign: enthalpy changes of vaporization are always positive (heat is absorbed by the substance); whereas enthalpy changes of condensation are always negative (heat is released by the substance).

In practice it is seen that Gibbs free energy falls with increasing temperature, formation of gas is favoured. The discontinuous (involving latent heat) transformation between two phases is given by the well-known Clausius-Clapeyron relation.

$$\frac{dP}{dT} = \frac{L}{T\Delta v} = \frac{\Delta s}{\Delta v}$$

where L is the specific latent heat, T is the temperature, Δv is the specific volume change of the phase transition, and Δs is the specific entropy change of the phase transition. This relationship was given in 1850 by Clausius. ***It must be remembered here that the Clausius-Clapeyron equation holds good only if L is non-zero. It cannot be applied to cases where there is no latent heat!!***

With this brief digression from the state of understanding of phases and phase transitions (1800-1870), we go back to University of Leiden, where an important act was about to take place. By 1922, in the low temperature laboratory at University of Leiden, Nobel Laureate Prof. Onnes had retired and W. H. Keesom (See Box item 2) had taken over and continued the measurements along with his co-workers. In a series of measurements on the dielectric constant of liquid helium, they had noted a rapid change in galvanometer reading as their sample was cooled, which suggested occurrence of a phase transition. There was no change in appearance of the liquid, nor were any clear demarcation of the interphase between liquids, and **no associated latent heat**. They hypothesized that there had to be two phases and named them He-I and He-II with latter below the critical temperature [2].

In 1932, Keesom and Clusius observed that the heat capacity increase to a finite value and then jump to a much lower value-about one third of the maximum. They assigned a discontinuous curve to the data and because it resembled the Greek letter this new transition was called the "lambda transition"[3] (see figure 1). The result of Keesom was published as part of proceedings of the meeting of the Dutch Royal Academy of Sciences of February25, 1933.

Ehrenfest and Landau: Ehrenfest introduced his mathematical paper in the same volume of Communications from the Physics Laboratory of the University of Leiden, Supplement 75b, [4] to explain the difference between the observed helium transition and transitions observed so far, during those times in a large number of systems: lack of any volume change or entropy change across the transition. Ehrenfest's approach was strictly mathematical. He postulated that in a P-T plane in the constant Gibbs free energy (G=U-TS+PV) surface, when the one of the first derivative is discontinuous, the G surface is kinked – these kinks were called first order discontinuities. There is a jump in

$$S = \left(\frac{\partial G}{\partial T}\right)_T \quad V = \left(\frac{\partial G}{\partial p}\right)_T$$ at the transition point.

Similarly, when there is a jump in the second derivative it is called second order. Ehrenfest generalized it for classes called distinct higher order discontinuous curves. *In those times it must be remembered that there were no known examples of higher order phase transitions except the so called first! Hence, phase transitions were classified into orders on the basis of the behavior of Gibbs free energy and this classification continued to dominate the classification schemes for several decades!* Immediately the classification scheme was applied to realm of superconductivity by Rutgers in 1934. *However, even way back in 1934, Eduard Justi and Max von Laue [5] argued that Ehrenfest's notion of second order transition was mathematically impossible.* However, their objection was not accepted and the Ehrenfest classification was successfully advocated in text books and journals.

Landau has disregarded the objections raised on this scheme, developed a theory of second order phase transitions and devoted a chapter in their classic book "Statistical Physics" by Landau and Lifshitz (1938) [6]. In this book they presented an alternative scheme based on symmetry considerations, which however, overlapped considerably with Ehrenfest classification. They only claim that the second order transitions ***may also exist***. By 1940s the two schemes were hybridized and got general acceptance. However, it was realized that "lambda" transition could no longer be categorized under the Ehrenfest classification scheme; hence the scheme had to be supplanted by a broader scheme.

Mnyukh (see box item 3) has published a series of papers wherein he discusses fundamental aspects of the Ehrenfest scheme to put forth his arguments for establishing that "second order phase transitions cannot materialize and hence do not exist" [7]. He looks at the Ehrenfest Scheme from two very critical angles (i) look at the possible mechanism of transition in first and second order transitions and (ii) look for clear signatures of characteristics of a second order transition (see box item 4). We will now give a few examples from the literature published by Mnyukh et al., wherein he puts forth the essential result that second order phase transitions do not exist.

Revisiting of second order phase transition in the light of shrouding of controversies: Myriad of exotic nomenclatures has been coined to elucidate the phase transition (PT) in condensed media depending on the involved mechanisms or taste of their proponent researchers. Mnyukh has strongly argued that the first order phase transition (FOPT), inherently involving change in crystal structure which basically culminates via nucleation and growth process, is a universal phenomenon that solely encompasses all sorts of phase transitions. **In nutshell*, it is stressed that FOPT is ubiquitous phenomenon in entire condensed media which occurs via nucleation-and-growth molecular mechanism and macroscopically reveals itself in terms of phase coexistence, interfaces, range of transition and the hysteresis*.**

On the other hand, among the vast literature dealing to understand the phase transitions, plethora of them endowed with sophisticated theories, are dedicated to the second order phase transitions (SOPT) which remarkably differ from the FOPT. There are three important attributes of SOPT: *critical phenomenon, cooperative process and thermal fluctuation*. The occurrence of such phase transition at T_C is a continuous process which culminates via a cooperative phenomenon.

At this juncture the moot question which needs to be settled is: how to unequivocally identify that a given transition is FOTP or SOPT? Taking the recourse from literature, one finds four reliable indicators to discern FOPT which are: *presence of interface, detection of two phase coexistence*, *hysteresis of any physical property and involvement of latent heat.* As all these indicators are intimately connected, experimental verification of any one of them will be sufficient to ascertain FOPT. On the other hand SOPT requires that physical state of the two phases at the "critical point T_C" must be identical. It means that the negation of all indicators of FOPT is quintessential to establish the SOPT. In other words indicators of SOPT are: *absence of interface, absence of latent heat, absence of hysteresis and non-coexistence of two phases*.

In the light of controversy raised by Mnyukh who has summarily ruled out the very existence of SOPT, it will be apt to re-look into some of the celebrated phenomenon and examples attributed to SOPT and juxtapose them along with arguments favouring FOPT based on the aforementioned experimental indicators to distinguish between FOPT and SOPT. *In what follow, we critically examine some such examples/phenomena as given below:*

Critical phenomena: The critical phenomena have been reported in the phase transitions of various systems such as Liquid-gas, ferromagnetic, antiferromagnetic, ferroelectric, liquid Helium, superconductors and in liquid - solid binary systems. These are theoretically dealt within the ingredients complying with SOPT. Here we critically examine at least one of the startling examples pertaining to SOTP: ***critical opalescence*** (*a milky appearance of the liquid due to density fluctuations at all possible wavelengths*) around liquid –gas critical point. It is claimed that at the verge of the liquid – gas critical point, there is a great enhancement in the density fluctuations and the correlations of these fluctuations gives rise to *critical opalescence.* This phenomenon is considered to arise in the region of continuous phase transition and is theoretically consistent with SOPT [8]. However, the consideration of *critical opalescence* to be SOPT is now contrasted from the fact that the thermal fluctuation increases with increasing temperature. As the critical opalescence is purportedly driven by thermal fluctuations, it is thus expected to increase with the rising of temperature toward its critical point T_C. On the contrary, the experimental observations reveal that the opalescence appears only upon decreasing temperature. This cast shadow on the efficacy of thermal fluctuation as driving force of SOPT. On the other hand, the explanation of *critical opalescence* can be provided based on nucleation and growth phenomenon as follows: Beyond certain equilibrium temperature T_o in liquid – gas transition regime, the nucleation of tiny liquid phase at various sites starts growing and coalesce into liquid phase leading to the formation of gas/liquid interface. This description ~~is~~ favours the FOPT. In addition, light scattering experiments revealing sharp central peak of scattered intensity at T_C due to *critical opalescence* in various systems *(e.g.* NH_4Cl*,* K_2PO_4), is now claimed to have perceptible transition width in a range of temperature around T_C and also possess hysteresis. This is argued to be consistent with FOPT rather than SOPT [9].

Phase transition in ferromagnetic systems: Nearly all ferromagnetic to paramagnetic phase transitions are regarded as continuous / SOPT which occur without structural change and without assistance of latent heat, and thus complies with the theory of critical phenomena of statistical mechanics. The ferromagnetic phase transition in Ni (T_c =631 K), Fe (T_c =1043

K) and Co (T_c =1423 K) are the most typical examples second-order phase transitions. However, recent electrical resistivity and DSC studies in Ni, Fe, Co and $CoFe_2O_4$(Tc =760 K) have clearly revealed discernable thermal hysteresis and latent heat and thereby prove that so called SOPT in these systems turn out to be FOPT [12]. This has substantiated the proposition of Mnyukh that *all* ferromagnetic phase transitions are "magnetostructural" and hence to be treated as FOPT[13]

Normal – Superconducting Phase Transitions: Detailed thermodynamic studies performed on superconducting system reveal that the normal to superconducting state transition at its critical temperature T_C as well at 0 K occurs without involvement of any latent heat. X-ray diffraction experiment in Pb superconductor across the transition confirms that no change in crystal structure occurs during the phase transition around T_C. This evidently indicates SOPT in superconductors, which can be meticulously dealt within the framework of Ginzburg – Landau theory. However, in the presence of magnetic field, the XRD studies on single crystals of lead, aluminium and gallium showed dimensional and volume changes upon their *normal – superconducting* phase transitions [14] In some high temperature superconductor such as $YBa_2Cu_3O_7$, the structural distortion at T_c has also been reported [15] These results emboldened Mnyukh to suggest that all superconducting transitions are FOPT which involve structural change and hence occur via nucleation-and-growth molecular mechanism.

Nonetheless, the recent studies performed by high-resolution XRD measurements has refuted the claim of Mnyukh by bringing out the fact that there are no changes in the crystal structure or the latent heat release at the superconducting transitions, but its electronic properties are drastically altered [16]. These studies turned the table in favour SOPT in superconductors. It should be remarked that as long as great deal of experimental studies performed on variety of superconductors are unable to reveal the involvement of latent heat, the SOPT in normal to superconducting state cannot be discarded. More precise experiments are required to settle the turn and twist controversy still persisting in superconducting transition.

6. Summary The controversy shrouding the very existence of SOPT proclaimed by Mnyukh is definitely based on certain experimental facts supported by logical assertions and speculations. On the other hand, there are many systems which exhibit sharp transition akin to critical phenomenon and gel very well with the well established theories dealing with SOPT. At the same time, subsequent measurements in some of these system revealing sizable range of transition and presence of hysteresis definitely put forth a question mark on the existence of "critical point T_C " itself. It appears that answer to the controversy of FOPT versus SOPT may lie in the ***kinetics of the phase transition*** in a given system. In many systems, the phase transitions remain kinetically sluggish and take the recourse of a nucleation and growth mechanism while latent heat is explicitly involved in the accomplishment of the transition. In such discrete transitions, the coexistence of the two competing phases vividly observed at the range of transition temperature. There are other sets of systems which exhibit very sharp transition around T_C due to extremely fast kinetics which eclipse the observation of nucleation and growth processes and rules out the involvement of latent heat being much lower than the measurement limit of equipment. Consequently such transitions appear to be driven by cooperative phenomenon which mimick the so called continuous /SOPT. **Present discussion definitely calls the attention of researchers to re-look the phase transition in condensed media in holistic manner by performing detailed measurements using highly sensitive techniques to settle this controversy.**

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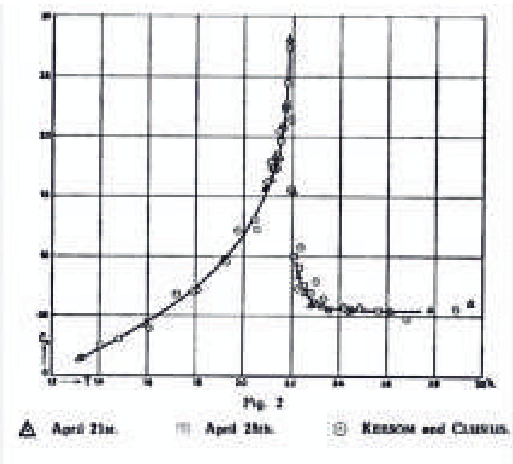
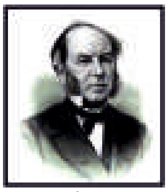


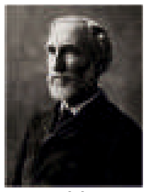
Specific heat C vesus temperature K for liquid Helium, Keesom and Clusius (1932)

Fig. 1

Cagniard



Andrews



Gibbs

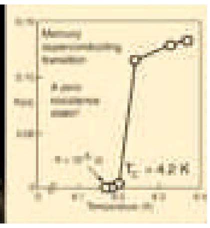
Baron Charles Cagniard de la Tour: In 1822, he discovered the critical point of a substance in his famous cannon barrel experiments. Listening to discontinuities in the sound of a rolling flint ball in a sealed cannon filled with fluids at various temperatures, he observed the critical temperature. Above this temperature, the densities of the liquid and gas phases become equal and the distinction between them disappears, resulting in a single supercritical fluid phase.

Thomas Andrews: His reputation mainly rests on his work with liquefaction of gases. In the 1860s he carried out a very complete inquiry into the gas laws—expressing the relations of pressure, temperature, and volume in carbon dioxide. In particular, he established the concepts of critical temperature and critical pressure, showing that a substance passes from vapor to liquid state without any breach of continuity.

Josiah Willard Gibbs: Gibbs's papers from the 1870s introduced the idea of expressing the internal energy U of a system in terms of the entropy S, in addition to the usual state-variables of volume V, pressure p, and temperature T. He also introduced the concept of the chemical potential μ a given chemical species. He also formulated the phase rule which is very useful concept in diverse areas, such as metallurgy, mineralogy, and petrology. Together with James Clerk Maxwell and Ludwig Boltzmann, Gibbs founded "statistical mechanics". https://en.wikipedia.org/

BOX 1

Onnes

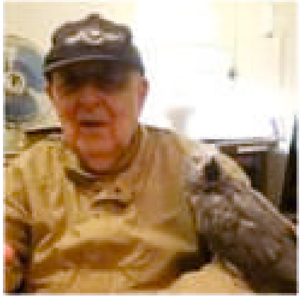


Keesom

Heike Kamerlingh Onnes, a Nobel laureate. He exploited the Hampson–Linde cycle to investigate how materials behave when cooled to nearly absolute zero and later to liquefy helium for the first time, in 1908. He also discovered superconductivity in 1911.

Willem Hendrik Keesom, in 1926, invented a method to freeze liquid helium. He was previously a student of **Heike Kamerlingh Onnes.** He also discovered the lambda point transition specific-heat maximum between Helium-I and Helium-II in 1930. https://en.wikipedia.org/

BOX 2



Yuri Mnyukh. Head of Crystal-Physics Laboratory, Institut of Biophisics, USSR Academy of Science prior to his leaving the Institute in 1973. Currently he is affiliated to New York University, Radiation and Solid-State Laboratory. He had begun publishing his ideas on phase transitions in crystals in a series of articles in the Journal of Physics and Chemistry of Solids.

BOX 3

Mechanisms of solid state phase transitions

A. An infinitesimal change in the thermodynamic parameter , say, T causes infinitesimal quantity of new phase to emerge with structure/properties changed by finite values

B. An infinitesimal change in the thermodynamic parameter , say, T a physical infinitesimal qualitative change occurs uniformly through out the whole macroscopic volume

A is of course, the well known-nucleation and growth mechanism and the issue is whether B exists in nature?

Characteristics of a second order phase transition

(i) Occurs at fixed critical point T_c where two crystal structures are identical

(ii) Change is continuous

(iii) No hysteresis; no overheating or overcooling possible

(iv) No latent heat

BOX 4

Authors -

L to R:

N.V. Chandra Shekar is Head, Condensed Matter Physics Division and Professor, Homi Bhabha National Institute, a deemed to be University under Department of Atomic Energy.

Awadhesh Mani is Head, Low Temperature Studies Section of the Condensed Matter Physics Division and Professor, Homi Bhabha National Institute, a deemed to be University under Department of Atomic Energy.

R . Baskaran is Head , SQUIDs and Applications Section.

Article

PHYSICISTS WE COME ACROSS IN OUR UG LAB

Bhupati Chakrabarti

Formerly of Department of Physics, City College, Kolkata 700009

chakrabhu@gmail.comm

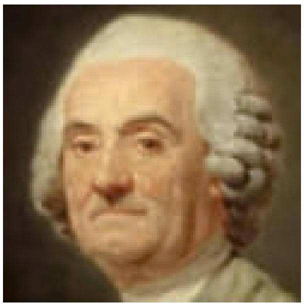
Abstract: *Up to the plus two level students come across the experiments where the names like Archimedes, Robert Boyle, Georg Simon Ohm, Willebrord Snell and some more are associated with. In the UG lab these names increases manifold as not only the experiments devised and designed by a scientist is handled there but also the laboratory techniques developed by them are put to work and the students are expected to know these aspects in laboratory training. Unfortunately our text books do not provide much hint about the contributors and their roles in developing the experiments or some techniques that are widely used in the UG physics lab. An extra effort from the teachers in this regard may prove helpful for the students.*

Introduction

Physics is full of characters. Theories, experiments, laws, principles, procedures, given by the scientists who are otherwise known as physicists, mathematicians, astronomers or may be chemists often bear the name of the concerned scientist in the theme or concept. In the classroom we come across the laws and principles given by various scientists and bearing their names and our students still do some landmark experiments that were devised may be some 200 years back as those are so revealing and could establish some significant aspects of the subject. We also use certain procedures or set ups in the lab equipment bearing the name of a scientist who was possibly the first to devise that or he is one who had some special role in that. Lloyd's mirror, Carey Foster's Bridge, Wheatstone bridge, Lissajous figures or Melde's method or Young's modulus are just a few from that set. Sometimes the UG physics students come across certain procedures like Calendar and Barnes method for determination of J (no more used) or focussing a spectrometer by Schuster's method etc. bearing the name of one or more scientist. Of course more familiar names that are associated with experiments like Newton's ring, Maxwell's needle, Fresnel biprism, Kelvin double bridge or Thomson method form e/m determination are also part of the lab courses but the students do come across those names in other contexts as well. Here we shall try to take a closer look at the scientists whose names are oft uttered particularly in the lab but the students are not given much of an exposure about the scientists behind the contributions they are widely using.

Techniques for more accurate measurements

Vernier scale fitted to a slide calliper is possibly one of the most familiar instruments that we traditionally use in the physics laboratory. And a student often gets an exposure to it as equipment for the more accurate measurement of length. Vernier scale subsequently appears in spectrometers, polarimeters etc. for the more accurate measurements of angles also. The way a Vernier scale takes care of the lengths that come in between two marks in the main scale is not only amazing but the entire concept is mind-boggling though we often do not pay much attention to this ingenuity. In fact we start with the Vernier scale fitted with the slide callipers but go on to find similar scales fitted with the main scale in a spectrometer, polarimeter, and in some other instruments.



Joseph Pierre Vernier
(1580-1637)

What about the person behind this scale? Students possibly could guess that this scale was devised by someone whose name was Vernier. Yes, this is the contribution of a French physicist Joseph Pierre Vernier. He was born in Omanis and it belonged to Spain then and he was a mathematician and an instrument maker. He was born in 1580 and was only sixteen years younger than Galileo. He actually passed away in 1637, five years before Newton was born. So one can appreciate the time when he not only developed such a device for accurate measurement but could attach it to the main instrument for carrying out accurate measurement. He first actually attached it to a circular scale where the primary scale was such that the smallest scale division was half degree. Vernier's proposal was to attach a movable sector in this scale and this sector had thirty-one half degrees in length but was divided into thirty equal parts where each part consisting then of a half degree plus one minute. In measuring an angle in degrees, the arc minutes could be easily found out by noticing which division line of the sector coincided with a mark made in the quadrant.

Interestingly the idea of Vernier scale originally came from a famous German Astronomer Clavius who was actually senior to Galileo as he was born in 1538. However he could not think of attaching the device to a so called main scale for easy measurement and the credit goes to Pierre Vernier. Nowadays even after the introduction of the digital attachments in the slide callipers that provide accurate readings directly and where one really need not count the actual number of coinciding divisions the attachment is fondly called 'digital Vernier'.

Visual representation of some mathematical predictions

The superposition of two simple harmonic oscillations gives us a combined oscillation leading to various patterns the complexity of which depends on the relative magnitude of the amplitudes, frequencies of the two oscillations and of course the phase difference between the two oscillations. The combined motion can generate straight lines with various inclinations, circle, ellipse of different orientations figure of eight etc among the simpler ones. These figures are known as Lissajous Figures and once again we understand that these were studied by some physicist whose name was Jules Antoine Lissajous (1822-1880). Well, Lissajous is once again a French physicist and the figures that we now know bearing his name was first shown by him through a device that he developed. It is known as Lissajous apparatus and it could show the figures that now bear his name.

Jules Antoine Lissajous (1822-1880)

Nineteenth century belonged to a great group of instrument makers. These were mostly mechanical in nature and were designed with a very specific purpose in mind. So the design of Lissajous for generating the drawing of the figures produced by the superposition of two SHMs. In the nineteenth century it was a great innovation as he allowed a beam of light to bounce off from a mirror attached to a vibrating tuning fork and then reflected off a second mirror attached to a perpendicularly oriented vibrating tuning fork. These two tuning forks could have different or similar frequencies and the reflected beam on falling onto a wall, resulted in a Lissajous figure. Interestingly a significant number of arrangements are now available to observe Lissajous figures. A good number of YouTube videos in this regard are quite useful now both for the students and the teachers.

All-important optics and spectroscopy

The name of Arthur Schuster (1851-1934) may be intimately connected with the focussing of a spectrometer but the contribution of this German born British physicist in various branches of physics is just remarkable. In the laboratory students use what is known as Schuster's method for the focussing of the spectrometers. He is also known for the Schuster integral, technique bearing his name. Schuster worked on the most advanced areas of his time. These included spectroscopy, electrochemistry, Optics, x-radiography and more. He was inducted as a fellow of Royal Society in 1879 when he was barely 28 years old. Among his many decorations his contribution was acknowledged by an Indian institution. He was awarded honorary doctorate by the University of Calcutta in 1908.

Arthur Schuster (1851-1934)

The main idea of so called focussing of a spectrometer lies in the fact that by suitable adjustments of the collimator and the telescope the source of light that is actually located at a finite distance has to be "effectively" sent to infinity. This will ensure the parallel beam of light entering the collimator and the spectrum thus formed will remain always focussed irrespective of its viewing position once this "Schuster focussing" has been done

Interestingly because of his German origin his loyalty was questioned in Britain when the First World War broke out in 1914. His brother was also a physicist in Britain and both of them had their sons joined British Army that fought against the Germans. In 1915 his son was injured in the war field while Arthur Schuster was speaking in the British Association as its President. In fact he and his brother had to issue statements mentioning that their sons were serving the British army in the war to refute the allegations against them that they were inclined towards Germany as it was their fatherland. Schuster was the first to introduce the idea of antimatter through a letter published in *Nature*. The mathematical basis of that was produced by another British physicist Paul Dirac. In all, the UG or PG physics lab the students as well as the teachers invariably utter his name while handling any experiment using a spectrometer.

Polarization of light is another important are where we come across a British scientist. Once you start using a spectrometer you are often given the task of the verification of Brewster's law for the polarised light. The law was given by British physicist David Brewster (1781-1868). The work of Brewster in the field of optics was very extensive and was well known. He was responsible for the development of what is known as kaleidoscope and that really made him known to the public domain.

Electrical measurements

In the UG physics laboratory there are certain set up of experiments that go in the name of the physicist who originally devised it. Before the entry of electronics based experiments in the UG lab electrical measurements used to dominate the scenario in a big way. Some of them were the contributions from otherwise not very well known physicist and the students of physics used to come across their names only in the laboratory while performing these experiments. And one must appreciate that these set of scientists emerged mostly in the nineteenth century as the current electricity actually came to be known only in the very early nineteenth century.

The first big example of from this group is the well-known network of four resistors is Wheatstone bridge as quite a few experiments were based on them with the suitable modifications by other scientists. The physicist associated with this bridge was Sir Charles Wheatstone (1802-1875). He was born virtually around the same time when current electricity dawned in. He was a physicist of Victorian era and was the key inventor of number of interesting instruments of that time. General public, particularly those who belonged to the upper crust of the society used to take interest in the scientific innovations that could be used not for science per se but for entertainment at that time. The affluent and aristocrat section of the society in their social gatherings used to expect some 'show' or trick based on science. Frankly this section of people was not interested in the science but were patrons of these types of innovations based on science. We must remember in this context that science was not a state supported vocation as we see it today. So the number of scientists at that time made some innovations mainly for entertainment purpose as that used to fetch some remuneration.

Sir Charles Wheatstone
(1802-1875)

Sir Charles actually invented stereoscope, a device for the display of three dimensional images. He was also responsible for the development of 'Playfair cipher' that was an encryption technique of that time. He has no doubt remained famous for the Wheatstone bridge bearing his name but the concept of the network of resistances for the measurement of unknown resistances was actually introduced by another British scientist Samuel Hunter Christie (1784-1865) who in 1833 came up with the idea. However it was popularised by Sir Charles Wheatstone in 1843 as the arrangement was used for the measurement of the resistances of wires used for the telegraph at that time. Soon this became a part of the activities of telegraph. And we have seen in India that the telegraph offices were actually the part of the Post Offices the doorway for communications even 50 years back. A portable modified version of Wheatstone bridge came to be known as Post Office box. I believe that any student of physics who is more than 50 years old must have used these bulky Post office boxes for the measurement of the resistance that are "neither too large nor too small". The Post office boxes are actually constructed on the principle of Wheatstone bridge.

Then we had George Carey Foster (1835-1919), another British physicist. The "bridge" bearing his name is once again the part of our physics laboratory. With the modified arrangement of Wheatstone bridge we could measure the relatively smaller resistances and that too quite quickly. He was a professor of physics in the University College, London. He was the mentor for John Ambrose Fleming (1849-1945) whose right and left had rules are known even to the school students of science and Sir Oliver lodge, the British physicist who worked on wireless communication.

Sir George Carey Foster
(1835-1919)

The quality training that Carey foster imparted to his students for the accurate measurements of the physical quantities was remarkable. In fact the accurate measurement was the integral part of the physics laboratory training in nineteenth century and we know how important these were. The accurate measurements are not only necessary for the sake of getting a very reliable value of a physical quantity it is only through these measurements any discrepancies in the existing theory may be detected. And that may lead to the more critical study and to the discovery of newer and till unknown phenomena.

Electromagnetism, thermoelectricity and electronics

The contribution of Michael Faraday (1791-1867) both in physics and chemistry is remarkable. Among other things he came up with the idea and experiment with electromagnetic induction in 1831. We now know how the idea has changed the world starting from the electric power production and developing so many machines. Interestingly the fact that the Faraday's laws of electromagnetic induction are rooted to the principles of conservation of energy was pointed out not by British scientist Faraday but by a scientist from Russia. He was of Baltic German ethnicity and we know him as Emil Lenz (1804-1865) who gave us Lenz's law. Though this law is intimately connected with the Faraday's law of electromagnetic induction and it was introduced immediately after the Faradays' work, yet it was a special contribution of Lenz that the students know once they come across the principles of EM induction.

Emil Lenz was born in 1804 in Latavia that was the part of Russian Empire. As a young scientist he undertook voyage to study the physical properties of seawater and climate conditions. In 1834 he came up with the law that now bears his name and the law has been beautifully summarised by D. J. Griffith as “Nature abhors change of flux” indicating how the direction of current developed because of the change of flux actually opposes the very cause that is the change of flux itself. So the entire exercise demand supply of energy to maintain the change of flux to go on and as a result we get new form of energy i.e. electricity. Interestingly Lenz also independently discovered the resistive heating by current flowing through it. This was the first one of the laws of heating given by James Prescott Joule (1818-1889) another British scientist. As an acknowledgement of the contribution of Lenz in the Joule's first law of heating while current is passing through a resistor and it is now known as the Joule-Lenz law.

Thermoelectricity is a branch of electricity that also emerged in nineteenth century. The Seebeck effect and the Peltier effect were given by two scientists that nowadays have got a combined name of Seebeck-Peltier effect. Thomas Johann Seebeck (1770-1831) was a German and lived in present day Tillanin that is the capital of Estonia in the Baltic region. He actually had a medical degree but shifted his focus to physics. He discovered what he called thermo-magnetic effect where he could show that a magnetic needle gets deflected if kept close to a junction of a dissimilar material. It was 1823 and Hans Christian Oersted the Danish scientist who discovered the magnetic effect of electric current in 1820 actually corrected the conclusion of Seebeck by pointing out that the deflection of the magnetic needle is due to the electric current that has been produced because of a temperature gradient in the junction of dissimilar materials. It came to be known as thermo electric effect. Jean Charles Athanase Peltier (1785-1845) was a French watchmaker and used to deal with watches till he was 30 years old. He could notice the development and absorption of heat in a voltaic circuit with dissimilar metals. This effect came to be known as Peltier effect. Peltier worked on various fields including atmospheric electricity and meteorology. Now the effects discovered by Seebeck and Peltier are together named as Seebeck-Peltier effect as they both are of same origin. The third principle of generation of thermoelectricity i.e. Thomson effect was given in 1854 by William Thomson (1824-1907) who later came to be known as Lord Kelvin. In the physics laboratory the experiments using thermocouple make the students learn about the contribution of these scientists.

The students come across various types of solid state or semiconductor diodes in the UG physics lab. These include p-n junction diode, light emitting diode (LED), photodiode, Zener diode etc. Among these only Zener diode has been named after Clarance Zener (1905-1993) who in 1934 first came up with the idea and described the principle that such a diode may be made. He was a theoretical physicist of highest calibre and worked in wide number of fields including superconductivity, ferromagnetism, elasticity, Diffusion, geometric programming. Numbers of his contributions were in the field of engineering.

Some more physicists who mainly 'reside' in the lab

In the following table the contributions of some of the scientists the names of whom are has been summed up. Some of their contributions may not be in use in the present day UG laboratories but in the physics community there are number of people who worked with the experiments devised by these stalwarts. However this list is by no means exhaustive.

Concluding remarks

There are actually many more scientists whose contributions have led to the understanding of physical principles and we are

Name of the scientist	Nationality	Area/experiment, the Scientist is associated with
Thomas Young (1773 -1829)	British	Young's modulus, Interference through double Slit, wave theory of light
Franz Melde (1832-1901)	German	Melde's experiment for the determination of frequency
Hugh Langbourne Calender (1864 - 1930) & E. H. Griffiths (1851-1932)	British	Calendar and Griffiths Bridge for the measurement by platinum resistance thermometer
August Adolf Kundt (1839-1894)	German	Kundt's tube for the formation of stationary waves & measurement sound waves
John Jurin (1784-1850)	British	Jurin's law (he was basically an FRCS, a physician)
Henry Kater (1777-1835)	British (German Descent)	Kater's pendulum. It was an important gravimeter till 1930
Humphrey Lloyd (1808-1881)	Irish	Lloyd's mirror arrangement for the interference of light
Franz Mauritus Jaeger (1877-1945)	Dutch	Determination of surface tension, a method named after him

doing experiments based on them in the UG physics lab. Sometimes we are following some methods or doing an experiment in the lab without knowing the scientist who either developed it or worked for its improvement. Moreover some of these techniques have become obsolete after serving its purpose for a long time. An experiment for the determination of surface tension from the measurement on surface waves was done by the post graduate physics students in the University of Calcutta for a long time. Two researchers P.N. Ghosh and D. Banerji in the Department of Physics (CU) actually developed it and published a paper in Nature in 1925 and the method is based on that.

If the students are encouraged by the teachers to know more about these scientists who belonged to a different time one may find a good thread in the historical development of various scientific principles and methods along with some of the landmark experiments that have been long used in physics labs. Highlighting the roles of these contributors of physics through science exhibition, science talks or discussions is likely to make the students appreciate these contributions against the backdrop of the social scenario and scientific environment. And a small piece of history of science may be highlighted to the students.

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Article

ON THE VISIBILITY OF MOUNTAINS AND THE CURVATURE OF THE EARTH

Vijay A Singh

Physics Department, Centre for Excellence in Basic Sciences, Mumbai University, Kalina, Mumbai 400093

Arnav Singh

M B International School, Sector-8, Mahaveer Nagar, Kota, India 324005

Abstract

Lock down due to COVID-19 has resulted in significant improvement in air quality and excellent visibility. Sighting of distant peaks are being reported from North India towns, akin to those recorded in accounts by renowned Orientalists in the 18th and 19th century, India. However, can the peak in question even be viewed from the mentioned point of observation, considering that the Earth's curvature may block the line of sight? We analyze some recent observations of the Dhauladhar range from Ludhiana. Examining old records we identify a surprising error in the reported sighting of a peakin 1784 by Sir William Jones, a pioneer Orientalist and the founder of the Asiatic Society of Bengal.

1 INTRODUCTION

Owing to COVID-19, restrictions on movement of people and goods have been imposed in many parts of the world. This has resulted in a dramatic improvement in air quality. There were multiple reports of far of mountains becoming visible from urban areas. In Section 2, we calculate the apparent height visible to a faraway observer, taking into account obstruction of the field of view due to the earth's curvature. We apply these calculations to recent observations, in particular the Dhauladhar range from the plains of Punjab. We calculate its apparent height and the angular width in the sky.

In Section 3, we address some possible inaccuracies in a historical record attributed to Sir William Jones, a pioneer Orientalist and founder of the Asiatic Society of Bengal and a similar one by Henry Colebrooke his successor. Calculations suggest that Mt Jomolhari (in present day Bhutan), which he claimed to have sighted from Bhagalpur (in present day India), could not possibly be viewed from Bhagalpur. We try to identify the peak that he had actually sighted.

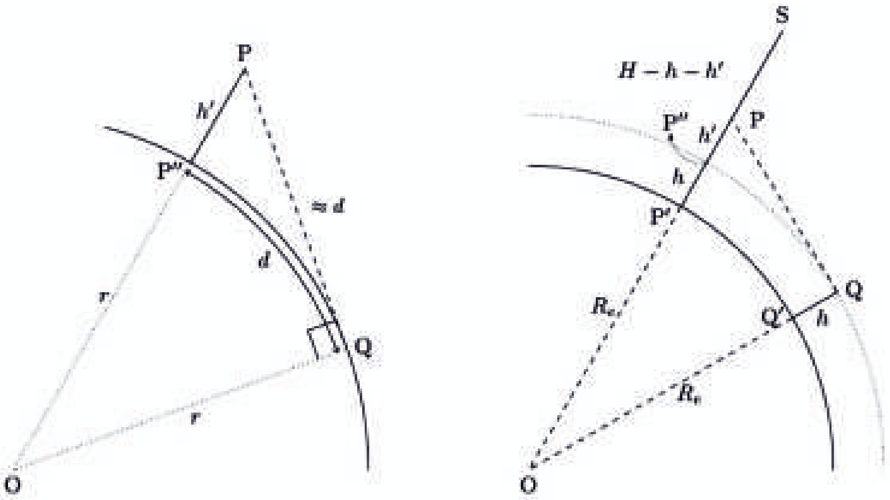
It maybe kept in mind that we are ignoring atmospehric scattering and absorption effects. We also remind the reader that sightings of over 300 km are possible given the right conditions (Bohren and Fraser, 1986).

2 APPARENT HEIGHT

In order to understand the effect of the Earth's curvature on the line of sight, we examine the well-known horizon problem.

Consider a sphere of radius r and centre O and a point P at a distance $h' \ll r$ above the surface at P''. Let the furthest point on the sphere visible from P be Q. Let the distance $P''Q$ (measured along sphere) be d (see Fig 1a).

Note that $QP \approx QP'' = d$. Since PQ is a tangent to the sphere, $\angle OQP = 90°$ and $OP^2 = PQ^2 + OQ^2$. Since $h' \ll r$, it is reasonable to carry out the following approximations.



(a) Distance to horizon for an observer at P. Obviously PQ is a tangent to the sphere.

(b) Apparent height of mountain P'S as viewed by an observer at Q

Figure 1: Diagrams

$$(r + h')^2 = d^2 + r^2$$
$$2rh' \approx d^2 \text{ as } h' \ll r$$
$$d = \sqrt{2rh'}$$

Thus, distance to the horizon as viewed from an elevation of $h' \ll r$ is given by $\sqrt{2rh'}$. Reversing this argument, we may say that for an observer at a distance $d = \sqrt{2rh'}$ from a mountain, only that portion of it which is above elevation h' will be visible. So the scaling law is clear; if you go 4 four times higher you will only see twice as far. Hunters even in primitive times would climb tall trees or go up hillocks to sight prey far away.

We now examine if the observer too is at elevation $h \ll R_e$ at a point Q (see Fig.1b). Here we take $r = R_e + h$, where R_e is the radius of the Earth. The peak is of height P'S = H. Thus the tangent to Q is drawn from P. Note PP' = h + h'. H' is the apparent height of the peak as viewed by the observer at Q.

$$h' = \frac{d^2}{2(R_e + h)} \approx \frac{d^2}{2R_e}$$
$$H' \approx PS = H - h' - h$$
$$\boxed{H' = H - \frac{d^2}{2R_e} - h}$$

Figure 1: A view of the Dhauladhar range from Jalandhar**(TWITTER, 2020)**

Let us apply our calculations to recent sightings of the Dhauladhar range from the plains of Punjab. The figure below has one such view from the town of Jalandhar which is at mean sea level elevation of h= 228m and at distance $\mathrm{d} = 138\mathrm{km}$ from the Dhauladhar range. From the above discussion, the range, which has an actual height $\mathrm{H} = 5180\mathrm{m}$, will appear smaller. From the above formula, taking $\mathrm{R_e} = 6378\mathrm{km}$ and elevation of the place $\mathrm{h} = 228\mathrm{m}$ we get the apparent height $\mathrm{H}' = 3469\mathrm{m}$. Thus the peak is dwarfed by 33%. It subtends an angle $\theta = \frac{\mathrm{H}'}{\mathrm{d}} = 1.44°$ at the point of observation occupying a small but distictly visible part of the sky just above the horizon.

3 A Historical Analysis

These reports remind us of similar sightings two centuries ago by the pioneer Orientalist and founder of the Asiatic Society of Bengal, Sir William Jones. At the time he was stationed in Bhagalpur, then a British stronghold some 330 km north-west of Kolkata. In his own words (Keay, 2000, pp. 40-41)

> *Just after sunset on the 5th of October 1784, I had a distinct view from Bhagilpoor (Bhagalpur on the south bank of the Ganga) of the peak of Chumalary (Mt. Jomolhari in Bhutan) ...the horizontal distance at which it was distinctly visible must be at least 244 British miles (390 km)*

Using geographic data, we compile the values of d, h and H' for Mt. Jomolhari and other Himalayan mountains in the vicinity.

Mountain	$\mathrm{H/m}$	$\mathrm{d/km}$	$\mathrm{H'/m}$
Mt. Everest	8848	305.97	1495
Mt. Makalu	8485	294.40	1629
Mt. Jomolhari	7326	366.50	−3256 (NV)
Mt. Kanchenjunga	8586	297.33	1594
Mt. Lhotse	8516	302.71	1271

Table 1: Distance $\mathbf{d}$(km) between Bhagalpur and the peaks under consideration. **NV**=Not Visible as $\mathbf{H}' < 0$

Taking $\mathrm{R_e} = 6378\mathrm{km}$ and elevation of Bhagalpur $\mathrm{h} = 52\mathrm{m}$, we get $\mathrm{H}' = -3256\mathrm{m}$ for Mt. Jomolhari, which is appreciably negative. This indicates that Mt. Jomolhari could not possibly be visible from Bhagalpur. Among the other mountains, Mt. Kanchenjunga has coordinates closest to Mt. Jomolhari so it could possibly have been the mountain sighted by Sir William Jones.

This approach can be generalised to investigate other such sightings of mountains in historical records. It could also be useful high school activity for students on field trips to local mountains.

The moral of this article is two fold: simple geometrical/physics arguments can be used to critically examine reported data. And sometimes even the best of us can err.

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2. Agnihotri, A. (2020). Retrieved from Twitter: https://www.twitter.com/Anjuagnihotri1/status/1246023567998734337

3. Keay, J. (2000). *The Great Arc.* Harper Collins, Suffolk.

Feed–back from participants in
NAEST PRELIMS

The three experiments were extremely enriching both in terms of knowledge and technical ability. Performing these experiments that were based on simple mechanisms and daily phenomena gave me a new perspective to look things at. Details that would normally be overlooked were encouraged to be assessed in the report. The importance behind asking the question "Why?" was made clear by these experiments. The tasks pushed us to explore the underlying concepts and go more into the reason why something is happening. To summarise, these experiments made me realize the numerous ways physics could be linked to daily phenomena and happenings. This has changed my views and has given me a new perspective on physics. Thank you Anveshika.

Abhijeet Sreyas A.
12^{th} grade, Bangalore

The best part of NAEST was that it made me realize that physics is not just equations. It was the best manifestation of true meaning of physics. Such beautiful experiments from 'household stuff' blew up my mind.

Devesh Giri, Std. 12

It was very much interesting to perform the experiments and analyze the results to reach a conclusion. I would like to thank NAEST prelim for giving me a chance to learn and understand the concepts through experiments. This competition is very much unique as it takes the test of our experimental skills in physics. This test motivated me to judge the things in a different way and inspired me to think out of the box. All the three experiments were very much interesting. I am very much grateful to NANI for giving me a chance to perform physics experiments in my home during this pandemic period using the materials already available in my home. It helped me to visualize the things we read and to understand physics and analyze the things by observations.

Asmita Bhowmick
DAV Public School,Chirimiri CG

My experience with NAEST prelim has been amazing. It was great fun performing the experiments as one had to arrange the apparatus which involved a lot of creativity. I learned a lot and gained a lot of practical knowledge. I can say that it is true that: "The more we explore & perform experiments, the more we learn."

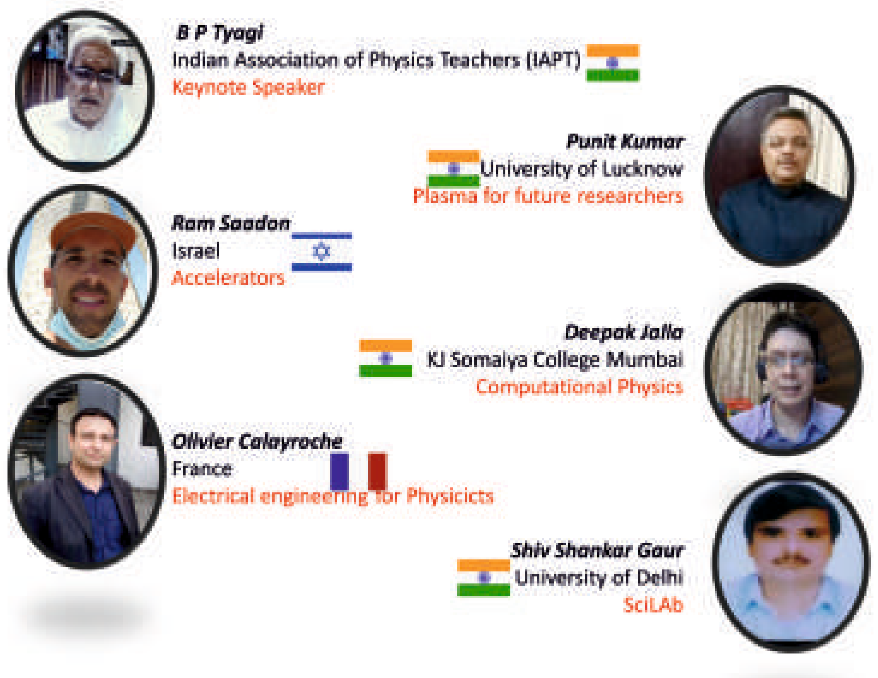
Astha Kalra, Std. 11

I want to highlight that the knowledge I gained from these experiments could not have been gained from reading any textbook. These experiments were unique in themselves. Each experiment involved new concepts in new ways which I had never thought of! It helped me develop my problem solving as well as situation understanding skills. I had a great time thinking about the possible ways of solving the problems. Every eligible student should try to appear in this.

Ayushman Tiwari

H C Verma
Co ordinator, NANI

International Short Course on Advanced Physics



Professional courses are an effective medium to update and upgrade the knowledge of working teachers. They are also equally useful for research scholars, working scientist and even postgraduates students. The covid-19 pandemic has imposed many restrictions in conduction of refresher course with physical presence; however advent of online resources made it possible to conduct short courses or refresher courses online overcoming the pandemic restrictions. Keeping this fact in mind an International short course on advanced physics was organized by department of Physics K J Somaiya College of Science and Commerce, Mumbai during 6th to 8th August 2020. It was organized online in a manner that the participant can enjoy the series of lectures at the time of their convenience and then appear for the interaction online.

The course was made available for everybody interested in Physics particularly in the advanced developments as given in the brochure. An online link was made available worldwide for the free of cost registration of the participants.

An over whelming response was observed. In addition to the participants from Mumbai, rest of Maharashtra and Indian States, a large number of participants joined from Argentina, Portugal , Greece, Ukraine and Mexico. Some resource persons were from Israel and France.

On the day of inauguration Dr B P Tyagi was invited to open the session and deliver the keynote address.

Dr Tyagi, coordinator for Examinations conducted by IAPT examinations , discussed the significance of online courses and also IAPT activities useful for teachers and students learning physics. He also shared his views highlighting the sustainability of Physics activities even during Corona pandemic.

Inauguration of the programme was conducted on zoom platform, in the presence of Patron Dr (Mrs) Pradnya Prabhu, principal of K J Somaiya college and the convener, Prof. Ranjana Shukla,Head, Department of Physics of the host college, shared by hundreds of participants and viewers worldwide.

Topics selected for the program where accelerators, electrical engineering for physicist, plasma for future physics researchers, computational physics and SciLab for the physicists.

In the opening session Ram Saadon from Israel discuss about elementary concept of particle accelerator along with collision theory and simple understanding of new particle production in the circular accelerators. He also discussed components involved in Large Hadron Collider for the beginners.

On 7th, the first session was electrical engineering for physicist and was conducted by Olivia from France. He, starting from very basic concept of electricity took his talk to smart homes, an application of development done on electrical automation. In the same evening Dr Punit Kumar from University of Lucknow discussed plasma and its applications. Most interestingly, the research avenues for the Physics post graduates in plasma research were his key points. Last day of the program was kept reserved for computation in Physics. On this day Deepak Jalla from the host Institute discussed about computation in physics, Julia and other useful software for Physics community. A session dedicated to 'SciLab' was the concluding one and delivered by Dr Shiv Shankar Gaur of Shivaji College (University of Delhi). He discussed solution of first and second order differential equation using the computer, then took Physics people to advance applications of SciLab as a freeware.

This whole course was completely open for question answers through different media. Our participants used chat box and WhatsApp mainly for their doubt clearance and of course, suggestions and interaction.

Special feature of this program was that the participants can have the lectures and sessions on their time and then appear for the online quiz. This method was adapted due to the observation that in online course it is difficult to attend in real time by the people on the other side of Globe having day night difference.

All the participants who attended complete set of program and scored a threshold in the quiz were given online certification soon after the program was over.

Needless to say this course served its purpose overcoming the technical hurdles appearing in its path and opened the future perspectives for the forthcoming online courses in Physics. The feedback of participants reveal that in general such online courses are good enough to meet the expectations of Participants including academic gain, flexibility in study time, no cost participation and above all a sustained attitude of Physics-sharing, free from pandemic reservations, however sparing the social interaction among participants.

Anshul Gupta, Pallavi Raote

Organizing Secretaries

The course is available at the following site for the benefit of readers

Day1 form:

https://forms.gle/EkKdBk8aBZjHikXh9

Day 2:

https://forms.gle/mbjrixCCEpoMs12EA

Day 3:

Report (Ammani- Anveshika)

Webinar -1

Topic: Creative Brain Tickling Technique

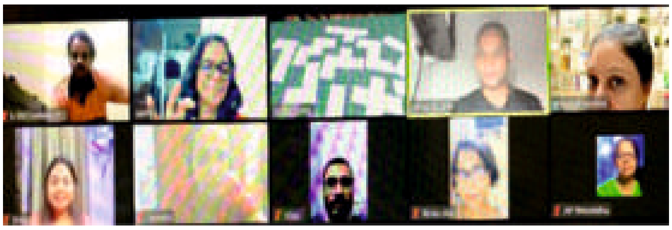
Organized by: Majlis

Anchored by: Ameet Kumar and Suruchi Agarwal

Platform: Zoom Meetings **Date:** October 2, 2020

No. of teachers: 40 from Delhi

Resource Person: Sarmistha Sahu



How do we go about solving a tricky problem?. To motivate oneself to overcome this challenge, the session "creating and tickling your brain" was suggested for proactive Majlis teachers.

A protocol was designed to step up one's thinking capabilities with first playing with Tangram model. Promptly, the participants took out their 7-piece coloured geometrical pictures, carefully crafted from cardboard and crayons.Square, rectangle, parallelogram, trapezium, rhombus, hexagon done successfully with a loud revelation by Ms Pragya Nopany, "Oh, all the figures have the same area!". So, learning many features while playing was confirmed.

Later, the participants were to make a rectangle,with 60 unit-squares. Then, chop them into 12 pentaminos of different shapes! Dismantle the pieces and re-join them again, CHALLENGE! Both making and breaking was fun and mind boggling.

"Kept me so busy, no time to answer", said Saikat. Suruchi applauds, " Wonderful brainstorming session". "Amazing session on puzzles", says Shalini. "Really felt like a child inside us", anonymous.

Webinar – 2

Topic: Planar angles with multiple reflections (Activity based)

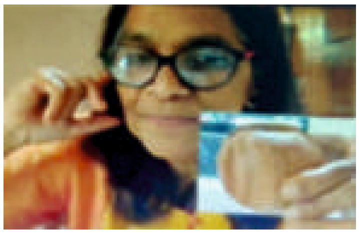
Organized by: MES Kishore Kendra, Bengluru

Anchored by: Ms Sumana R, HOD Physics.

Platform: Zoom Meetings **Date:** November 10, 2020

No. of students: 40 **No of teachers:** 10

Class: Std XI **Resource Person:** Sarmistha Sahu



The entire 2 hours program was well organised by young teachers of MES KK and attended by all the HODs, Principal, Vice Principal, and staff of the Physics department. Other staff from MES branches were special invitees.

Student's participation, the speed of answering, the interest and excitement in their voices was worth noting. Every step, they did, they learnt, and they answered very well. The teachers were equally participative. Students created their own theories, tested them with simple home-made gadgets, pronounced the relation, tested with many different cases, and concluded perfectly well. They tested it for different situation before they were satisfied. Scientists in the making!

Their response prompted the speaker to go beyond planar angles; they did well in solid angle session and finally established the relation for number of images and solid angle meticulously.

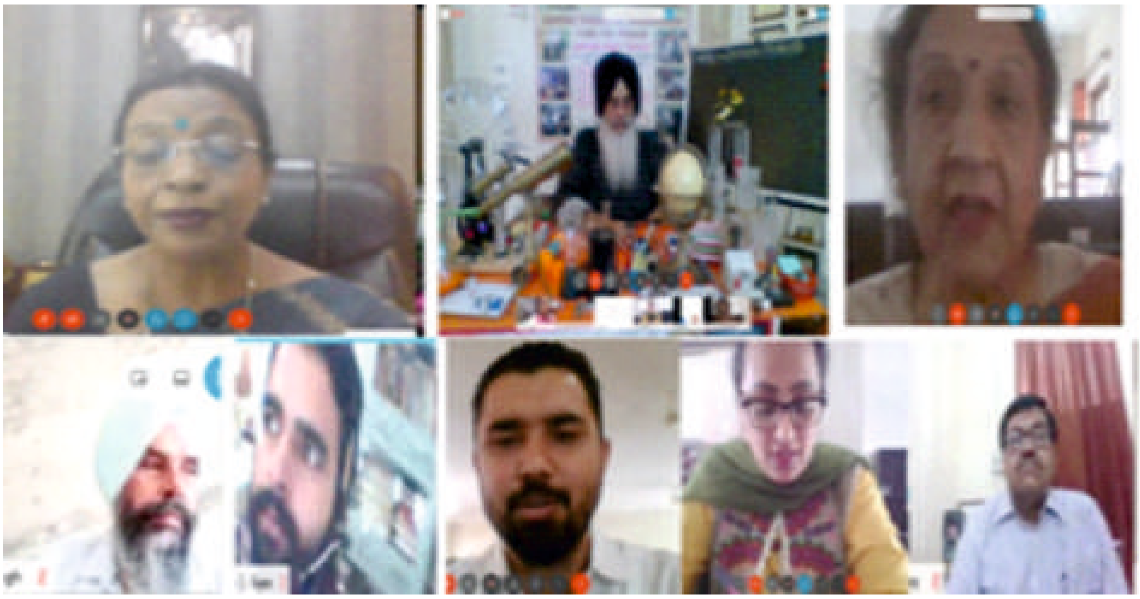
The students chorused " a full sphere"! The image space plus the object space is 4 steradians is what they observed from their activity!

Sarmistha Sahu

Coordinator

Report (RC-02)

National webinar cum e-workshop on unique way to physics



A National webinar cum e-workshop on unique way to Physics was organized at H.M.V. Collegiate Sr. Sec. School, Jalandhar on 12th October 2020 in association with IAPT RC-2. The event commenced with the traditional lamp lighting ceremony followed by Gayatri Mantra. Webinar Coordinator Mrs. Meenakshi Sayal gave a brief introduction about the webinar ant told them that they can learn basic concepts of Physics from objects available at their home in the era of COVID-19. She further emphasized that this practical exposure also helps to develop life skills like critical thinking, reasoning, creativity and problem solving among students. Principal Dr. Ajay Sareen in the inaugural address welcomed the resource persons. Total 650 participants including eminent educationists, faculty members and students from universities, colleges and schools joined the webinar on virtual platform.

Resource person Dr. Jaswinder Singh Shiksha Ratan and National Awardee, is famous for his "Jaswine Lab on wheels". He explained basic concepts of Physics with easy and interesting experiments. He explained the Concept of charge using charged balloon, Concept of open and closed circuit with Teflon tape, Electromagnetic Induction, Lenz's law etc.

Resource person Prof. Y.K. Vijay, Director CIST (IIS University, Jaipur), also President of RC-6, explained various phenomena of Physics like Quantum science in visible range, An harmonic oscillator, Atomic arrangements and effects, Alpha decay model etc. He also demonstrated Bohr's orbits. Dr. Major Singh, President RC-2 appreciated the presentation of resource persons and inspiring the students to learn Physics with Hands on Practice.

Dr. Rajeev Sharma, Secretary RC-2 apprised the audience about activities undertaken by IAPT. He accorded vote of thanks to all participants and resource persons in particular to Principal and faculty of institution for kind support in all endeavors of IAPT. Webinar was moderated by Mrs. Jaspreet Kalsi, Lecturer of Collegiate School.

Meenakshi Sayal

EC Member

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Regional Council RC-01 (Delhi-Haryana)

8th ANNUAL CONVENTION

October 10 & 11, 2020

The **8th** Annual Convention of the R C-01 (Delhi & Haryana) of the IAPT was organised online on Oct. 10 & 11, 2020 via Zoom platform. The chief guest of the programme was Prof. Rupamanjari Ghosh, Vice-Chancellor, Shiv Nadar University, Greater Noida (U.P). The programme started with a welcome address and introduction about IAPT activities by Dr. M.S. Bhandari, Secretary, (RC-1). It was followed by introduction about two-days programme by Dr. S. K. Singhal, Treasurer, (RC-01). He mentioned that this year the theme of the Convention was, "**Rethinking Physics Education in the Context of NEP- 2020"**. Invited talks by eminent experts were arranged and also papers were invited on three subthemes, namely (i) *Instructional Materials: Design and Developmen*t , (ii) *Assessment: Tools and Techniques*, and (iii) *Four Year UG Course: Examples from India and Challenges.* In all there were ten invited talks and eight paper presentations.

Prof. Ajoy K Ghatak , Meghnad Saha Professor of the National Academy of Sciences of India (NASI), Allahabad and former Professor of,IIT, Delhi was requested to introduce the Chief Guest, Prof. Ghosh. Prof. Ghatak informed that, she did her M.Sc. from Rajabazar Campus of University of Calcutta and Ph.D. from University of Rochester, USA where she worked as a *Rush Rees Fellow*. Her Ph.D.work under the supervision of Prof. Mandel on *Quantum Optics* finds mention in the book, "*The Age of Entanglement*" by Louisa Gilder published by Vintage in 2009.After her Ph.D., she joined JNU where she rose to become Dean, School of Physical Sciences and led a group on Quantum Optics. She joined Shiv Nadar University in July 2012 as the Founding Director of the School of Natural Sciences and took over as Vice- Chancellor in February.2016 and has since been at the helm of University's growth with her transformational leadership. She is recipient of many awards including the *Stree Shakti Science Samman* for her Original contribution to science and *DAE C. V. Raman Lecture award* in Physics in 2018-19. Prof. Ghatak invited Prof. Ghosh to deliver her address.

Prof. Ghosh, while thanking Prof. Ghatak , noted that this was the best form of recognition one gets when your 'guru' gets to introduce you. She noted that the context today is NEP 2020 and also the corona virus pandemic. The NEP talks about 'Liberal Arts', 'Multidisciplinarity', 'Disruptive Technologies' or 'Power of IT' and 'Skilling'. With examples, she emphasised that the term 'Liberal Art' is a misnomer and one cannot do Liberal Art without Science and Mathematics. It would be better to use, Liberal Studies' .In order to find solution to a problem in society, one has to keep context in mind. And this is where 'Multidisciplinarity' comes into picture. Further talking about Disruptive Technologies, she emphasized that the world needs sustainable solutions. We need smart materials, we need solution for energy, and we need to talk about health of common man and so on. All this we cannot do if we do not pay adequate attention to science education. There is a need to go deep into fundamental aspects of science. People should remember that application part of science is not immediate. Talking about her personal experience during her school days, she recalled that one science teacher told her that, ' *if you love science, you leave India and if you love India, you leave science'.* She said that she did not agree with that notion. But that was the notion prevalent at that time. She noted that India has come a long way. We have many eminent scientists in our country engaged in frontline research works but still *it is a long way to go.* In this context, she remarked that we do not take experimental science too seriously. It is not about repeating observations and getting nice plot but it is about understanding, 'why a particular set up did *not* work or 'how a particular set up did work'. She said that scientists should also pay attention to 'local issues' of society and engage themselves in finding local and sustainable solutions.

Talking about role of technology, she said that she strongly believes that technology should be at our service and should not dictate the pedagogy. There is tendency in our country to use the available technology and compromise with pedagogy. She mentioned that what has suffered in physics education is the *laboratory component*- 'the hands-on' learning part that we all believe in .She sees the future of education with 'hybrid model' where best of technology will combine with best of 'face-to-face' approach. Education is not only about getting credentials but it is 360° experience, peer-to- peer learning and more of social interactions. Every crisis presents some challenges which offer us opportunities. She added that she was sure we will come out of the present crisis richer.

In the end, she said that the NEP 2020 also talks about, 'skilling'. In her opinion, one mistake the system is doing is to create skilling outside higher education system. She said that Universities / Higher Education institutes prepare you with some kind of leadership *–leadership in thought*, *leadership in R & D jobs*, etc. One critical skill that we need to impart to our students is,'*how to think*' and not to restrict them to, '*what to think*'. 'Training of mind' never goes obsolete. She strongly believes that skilling should be within higher education system.

After this, Dr. M.S. Bhandari, Secretary, proposed the vote of thanks to the Chief guest, Prof. Ghosh. After which the programme started as per schedule given below. After each invited talk/paper presentation, time for Q&A session was allotted which was coordinated by Dr Yogesh Kumar. The programme went well as per schedule and at the end, vote of thanks was proposed by Dr Seema Vatsa.

The two-day programme was very well conducted by Dr Poonam Jain.

It was streamed live on YouTube and Face book and can be accessed on iaptrc1 account.
Programme

Time	**Event/Title**	**Speaker**
10 Oct.2020		
10:00-10:05	Welcome and Introduction to IAPT	Dr. M.S. Bhandari
10:05-10:07	Introduction to the Programme	Dr. S. K. Singhal
10:07-10:10	Introduction of Chief Guest	Prof. Ajoy K. Ghatak
10:10-10:20	Address by the Chief Guest	Prof. Rupamanjari Ghosh,
10:20-10:22	Vote of Thanks	Dr. M.S. Bhandari
10:22-11:00	Four year BS (UG) course at Indian Institute of Science	Prof. K. P. Ramesh I I Sc. Bengaluru
11:00-11:30	Art and Science of Learning Design in the Digital Age .	Dr. Pratibha Jolly Former Principal, Miranda House, University of Delhi, Delhi
11:30-12:00	Designing of Instructional Material	Prof. V. B. Bhatia, Former Professor of Physics, University of Delhi, Delhi
12:00-12:30	Assessment in Undergraduate Physics courses: The Experience at Azim Premji University	Prof. Rajaram Nityananda Azim Premji University, Bengaluru (Former Director, NCRA, TIFR, Pune &TIFR Centre for Interdisciplinary Sciences, Hyderabad)

12:30 -13:00	Assessment of Higher Order Skills in School Physics	Shri R. Joshi Former Assoc. Professor of Physics, NCERT, New Delhi
13:00-13:15	Teaching Physics Through Disruptive Technologies under NEP2020	Dr Amit Kumar, Asstt. Prof. Bhaskaracharya College of Applied Science, University of Delhi, Delhi
13;15-13;30	Industry-Academia Engagement in purview of NEP 2020	Dr Poonam Jain *, Dr.Yogesh Kumar and Ananya Banerjee Asstt. Prof., Sri Aurobindo College, University of Delhi, Delhi
13:30-13:45	Recasting Instructional Material leading to Remodelling of Assessment Methodology :NEP -2020 Perspective	Dr Punita Verma Assoc. Prof., Kalindi College University of Delhi, Delhi
11 Oct.2020		
10:00-10:30	A Research -centric four -year Physics UG Curriculum at Shiv Nadar University for fostering diverse Scientific skills	Dr. Samarendra Pratap Singh Assoc. Professor, Department of Physics, Shiv Nadar University, Gautam Buddha Nagar, U.P.
10:30-11:00	MCQ's and Assessment: Do's and Don'ts	Prof. Vijay A. Singh Visiting Professor, CEBS, Mumbai (Ex-Professor of Physics, IIT Kanpur and HBCSE(TIFR), Mumbai))
11:00-11:30	Practical Work and its Assessment	Prof. V. B. Bhatia, Former Professor of Physics, University of Delhi, Delhi
11:30-12:00	Designing Instruments of Physics Learning	Dr. Atul Mody Former Assoc. Prof. Of Physics, VES College of Arts, Science & Commerce, Mumbai
12:00 -12:30	Discovery-based and Inquiry -driven Undergraduate Physics Laboratories	Dr. Shirish Pathare Homi Bhabha Centre for Science Education, TIFR, Mumbai
12:30-12:45	New Dimensions of Assessing Students Learning in Physics	Ms Mohini Nagpal SSLT Gujarat Sen. Sec. School, Delhi
12:45-13:00	Curriculum for Multifaceted Development	**Dr Pushpa Bindal*** & Dr.Trinjita Srivastava Assoc. Prof., Kalindi College, Univ. of Delhi, Delhi
13:00-13:15	Four Year UG Course: Fluidity and Merits	**Dr.Trinjita Srivastava*** & Dr Pushpa Bindal Asstt. Prof., Kalindi College, University of Delhi, Delhi
13:15-13:30	Innovative way of Measuring fall of potential across potentiometer wire using ultrasonic sensor	**Dr Seema Vatsa** * and Prof. H.K.Sahjwani Asstt. Prof. Motilal Nehru College, University of Delhi, Delhi

13:30-13:45	A heuristic approach to Fermi statistics with few non - interactive fermions in one dimensional potentials\.	**Dr Partha Goswami*** and Dr Yogesh Kumar Assoc. Prof., D. B. College, Universit y of Delhi, Delhi
13:45-13:50	Vote of Thanks	Dr. Seema Vatsa EC Member, IAPT(RC1)

*** Paper presenter**

Webinar Team: Dr S.K. Singhal , Ms Vandana Banga, Dr Poonam Jain and Dr. Yogesh Kumar.

V P Srivastava
President, RC-01

Announcement

IAPT Committee for Prof. D. P. Khandelwal Birth Centenary Celebrations

This year in 2020-21 we remember with great respect our founding father Prof. D. P. Khandelwal on his birth centenary. This is to announce that a committee has been formed, as follows, to chalk out plans to celebrate Prof. Khandelwal's birth centenary.

Committee for Prof. D. P. Khandelwal Birth Centenary Celebrations

1. Dr. S. C. Samanta, (Midnapore WB) Convener
2. Prof. S. B. Welankar, (IPS Academy, Indore -MP)
3. Prof. Y. K. Vijay, Jaipur – Rajasthan
4. Dr. T. Ananthakrishnan, Kocchi, Bangalore
5. Prof. Mrs. RekhaGhorpade, Coordinator NCIEP (Mumbai)
6. Prof. Ravi Bhattacharjee, APhO Coordinator (Delhi)

In fact, Dr. Samanta initiated a curtain raiser activity in this regard jointly under the CSC Midnapore and RC-15 on October 01. IAPT members may please send their suggestions to the above Committee, which will come up with final suggestions in about two months' time. During the Birth Centenary Year, while we can think of national level activities in memory of Prof. Khandelwal, we request all the RCs to come with appropriate memorial events now in 2021. As our budget is limited, the RCs are requested to arrange the activities/programmes in collaboration with other organizations/ institutions.

K N Joshipura
General Secretary

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Dr. Sanjay Kr. Sharma
Managing Editor
Flat No. 206, Adarsh Complex,
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