



विद्या तत्त्व ज्योतिसमः

PADARTH

Newsletter



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March 2023

Department of Physics and Materials Science and Engineering
Jaypee Institute of Information Technology, Noida, U.P., India

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Message from Editorial Team

We all associated with Physics are familiar with the uncertainties of the quantum world. Interestingly, there are uncertainties in the classical world, too. This issue of “Padarth” is delayed as a consequence of the uncertainties of the classical world, and we are sorry for the undesired delay in sharing the activities of the Department with our colleagues, alumni, and well-wishers. We often face relations, indicating a kind of trade-off. For example, if you increase security of a place then privacy reduces. Similarly, if you measure position of a particle in a certain direction with reasonable accuracy, you cannot simultaneously measure the component of momentum of the same particle in the same direction with accuracy. We have a somewhat similar situation here. As this issue is a bit delayed, it's full of activities. From the time of the appearance of the last issue, the PMSE Department of JIIT has organized several events of different nature including but not restricted to Journal Club talks, Women in Science talks, International Conference, Open Quantum Day and Student Conferences.

You will be happy to know that the active journey of the Department is continuing and in near future we are going to organize several programs including faculty development program, Conference, Alumni talks. Before we close, it will be apt to note that in the last few months, our colleagues and PhD students have published a large number of papers in reputed journals, and the laboratories of the Department have been enriched with a set of new equipment and facilities. The Department is becoming more exciting with the joining of new faculty members, JRFs, PhD students, new DST funded projects, and with the addition of new research facilities. It's a continuous journey towards excellence and we need cooperation from you all in making our presence visible in the global map of Physics and Materials Science education and research. Finally, we would note that recently a set of exciting results on entanglement routing has appeared from the Department where efficient protocols for entangling initially non-entangled particles present in a network are proposed. We wish that with your help, this issue of Padarth will mimic those protocols and get us entangled with the students, alumni, parents of the students, scientists working in other places, and well-wishers of the PMSE Department.

Editorial Team: Prof. Anirban Pathak, Prof. Papia Chowdhury, Dr. B. C. Joshi & Dr. Anuraj Panwar

Events Organized

1. Women in Science Lecture Series

On the Eve of the 75 years of Independence, the National Academy of Sciences, India (NASI) is celebrating Azadi Ka Amrit Mahotsav through different science and society initiatives. As part of NASI's science and society initiative, Delhi Chapter of the NASI and Department of Physics and Materials Science and Engineering (PMSE), Jaypee Institute of Information Technology (JIIT, Noida) are jointly organizing a series of lectures entitled, "Women in Science Lecture Series". All the lectures of this series are being delivered by the eminent Women Scientists. The lectures are aimed to motivate young female students involved in UG, PG and PhD programs to continue science. All the talks had two parts. In one part, the speaker usually talked lucidly about her research works and the other part remains focused topics that inculcated confidence among the young students that even they can do top-class science and thus contribute to the society. Some practical problems that a growing scientist faces and how to circumvent those were discussed during the interaction sessions at the end. Till date eight lectures have been organized. Details of first three lectures have been published in last Padarth volume. Rest five lectures are as follows:

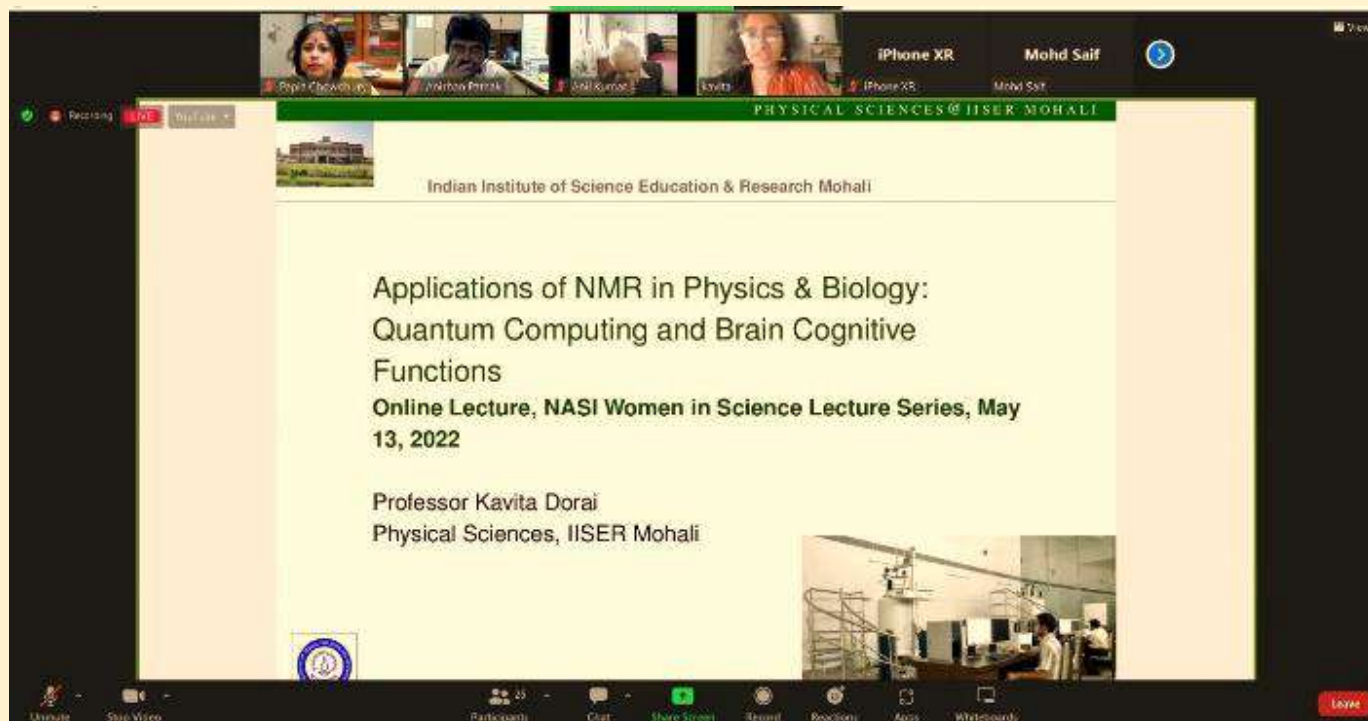
Women in Science Lecture 4



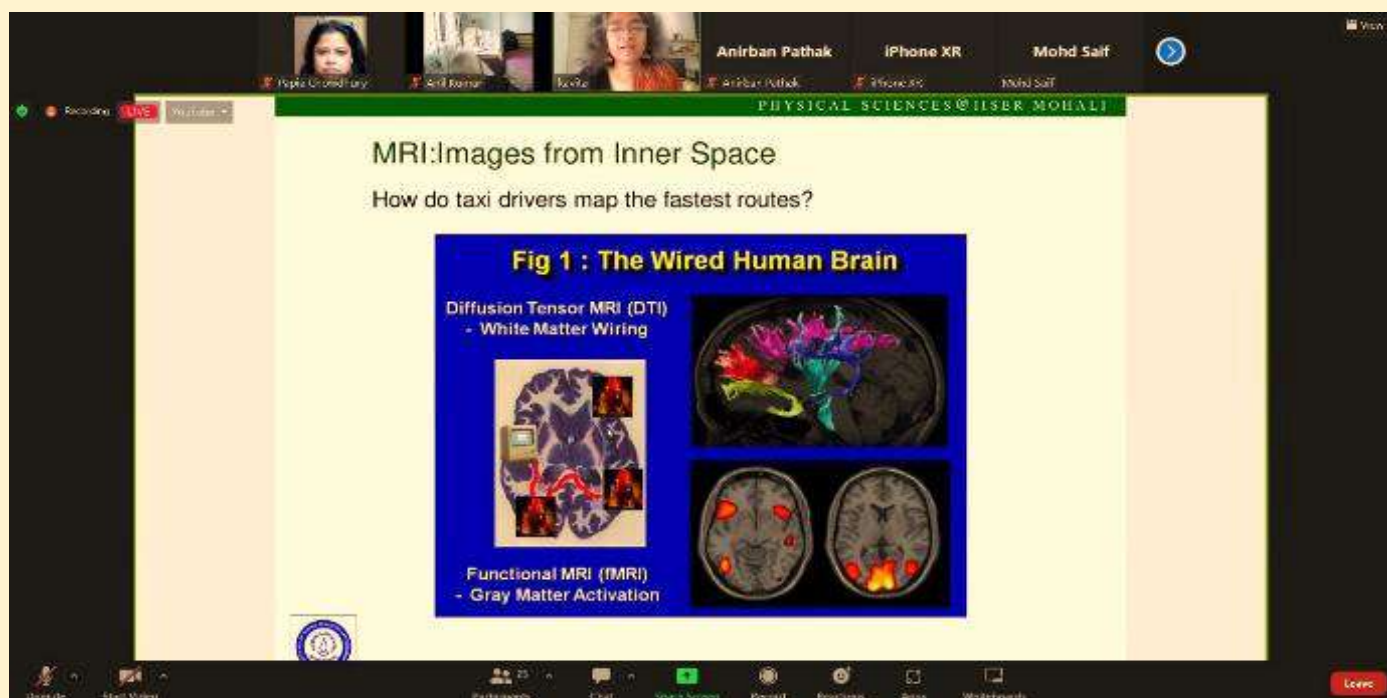
Fourth lecture of the series was delivered by Prof. Kavita Dorai, Department of Physical Sciences, Indian Institute of Science Education and Research, Mohali, Punjab on May 13th 2022. Topic of her talk was: Applications of NMR in Physics & Biology: Quantum Computing and Brain Cognitive Functions. Dr. Dorai is an NMR spectroscopist whose research is poised at the interface of Physics and Biology. She is deeply involved in the research area of NMR Quantum Computing, Metabolomics and Methodology Development. Her current research interests include

NMR Quantum Computing, Diffusion Studies using Gradient NMR, NMR of Nanomaterials, NMR Methodology Development and Biomolecular Structure and Dynamics Determination.

The talk began with the fundamentals of the NMR phenomenon. Prof. Dorai described the applications of NMR Spectroscopy in a versatile way in different fields of applied Science including Physics,



Chemistry, Biology, Environmental Science, Medical Diagnostics, Neuroscience, Materials Science and Geology. Her talk was also focused on two important and novel applications of NMR in quantum computing and brain cognitive functions. Total number of participants in this event were about 50.





Women in Science Lecture 5

Fifth lecture of the series was entitled “Improving engagement in science: the challenge” and it was delivered by Prof. Chandrima Shaha on 26th May, 2022. Dr. Chandrima Shaha is a biologist, President of the Indian National Science Academy, the premier body of science in India and JC Bose Chair Distinguished Professor at the Indian Institute of Chemical Biology at Kolkata. She is also the Former Director of the National Institute of Immunology, New Delhi. Her

Papia Chowdhury
Papia Chowdhury

Chandrima Shaha
chandrima.shaha

Anirban Pathak
Anirban Pathak

Ajoy Ghatak
Ajoy Ghatak

Jai Mittal
Jai Mittal

Dr. Kasturi Datta
Dr. Kasturi Datta

Improving engagement in science: the challenge

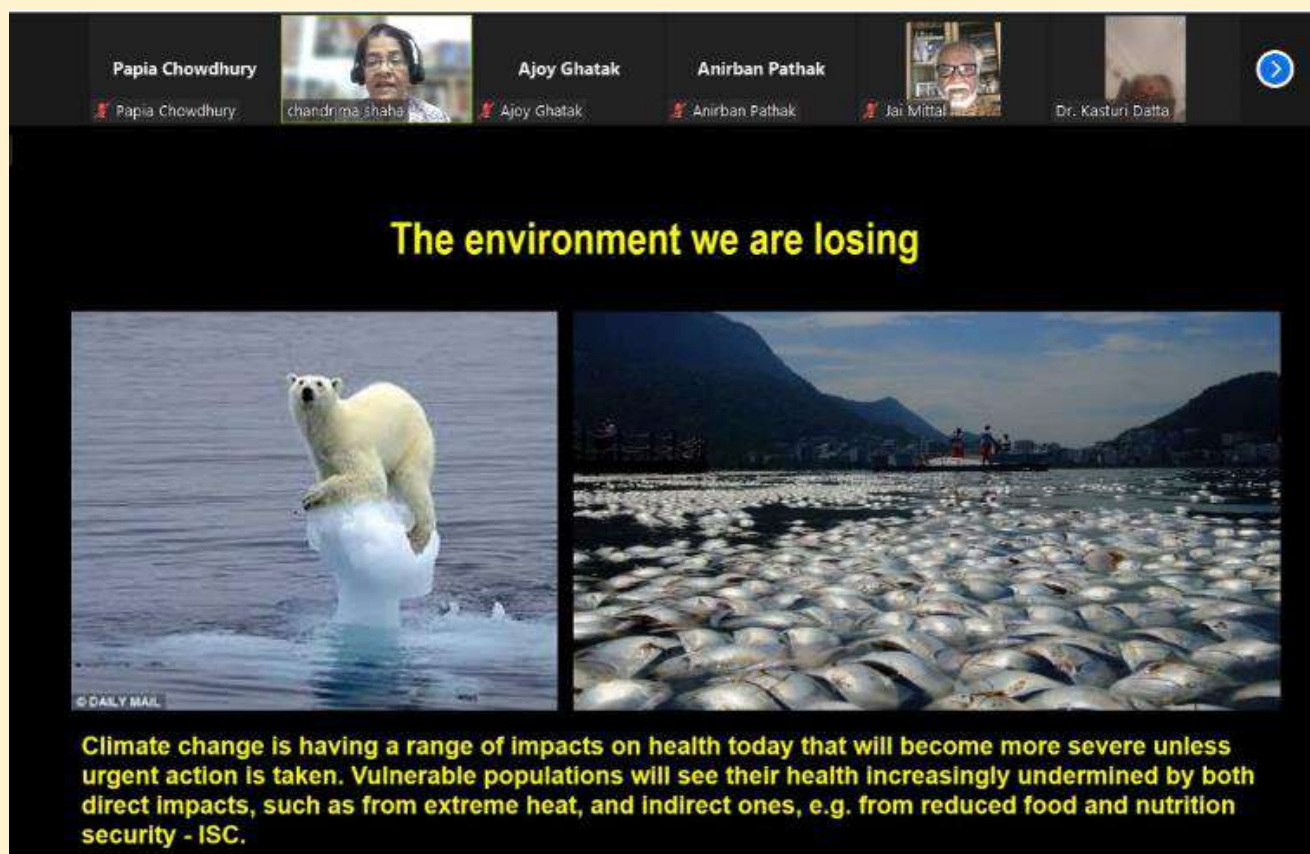
May 26, 2022

NASI Local Chapter - Delhi

Chandrima Shaha
Indian National Science Academy
National Academy of Sciences
Indian Institute of Chemical Biology

research interests’ centres around the elucidation of the processes that influence cell death programs under varying physiological conditions in diverse organisms. She is an elected fellow of the World Academy of Sciences and fellow of all three Science Academies of India. She served as a member in the Councils of all three National Academies. Notable awards include the Ranbaxy Science Foundation Award for basic sciences; the J.C. Bose Fellowship; Shanti Swarup Bhatnagar Medal of INSA; Om Prakash Bhasin Award; Archana Sharma Memorial Award; Darshan Ranganathan Memorial Award; Chandrakala Hora Memorial Medal and the Shakuntala Amir Chand Prize.

In her talk she has discussed about the engagement in science for both men and women. In Particular, she described about the engagement for women in Science which is important because the number of women involved in science is far less although they form half of the society. Total number of participants in lecture 5 was 70 which includes many eminent NASI, INSA senior fellows, faculties from various Institutes, graduate and post graduate level students from various science branches, PhD and Post Doc research scholars



The screenshot shows a Zoom meeting with six participants in the top bar: Papia Chowdhury, chandrima shaha, Ajoy Ghatak, Anirban Pathak, Jai Mittal, and Dr. Kasturi Datta. The main presentation slide has a black background with the title "The environment we are losing" in yellow text. Below the title are two side-by-side images: a polar bear standing on a small ice floe in the water, and a large number of dead fish floating on the surface of a body of water. At the bottom of the slide, there is a paragraph of yellow text: "Climate change is having a range of impacts on health today that will become more severe unless urgent action is taken. Vulnerable populations will see their health increasingly undermined by both direct impacts, such as from extreme heat, and indirect ones, e.g. from reduced food and nutrition security - ISC."

Women in Science Lecture 6



Sixth lecture of the series was delivered by Dr. Archana Sharma, a physicist and senior scientist at the CERN laboratory in Geneva, Switzerland, who was involved in the discovery of the Higgs boson particle in CERN. Talk was on August 24th 2022. Topic of her talk was: “Blue Sky Mega Science Research, Corona Virus, Why Should I Care?”.



Dr. Sharma is best known for her work in gaseous detectors, through which she contributed to the discovery of the Higgs boson. She has worked on the Compact Muon Solenoid (CMS) experiment in the Large Hadron Collider, for developing a new muon system called GEM (Gas Electron Multiplier). She is the co-owner of patent on a family of detectors called THRAC – Timing and High Rate Capable devices. She is an IEEE Senior. Dr. Sharma has been on board as honorary Adjunct professor is several





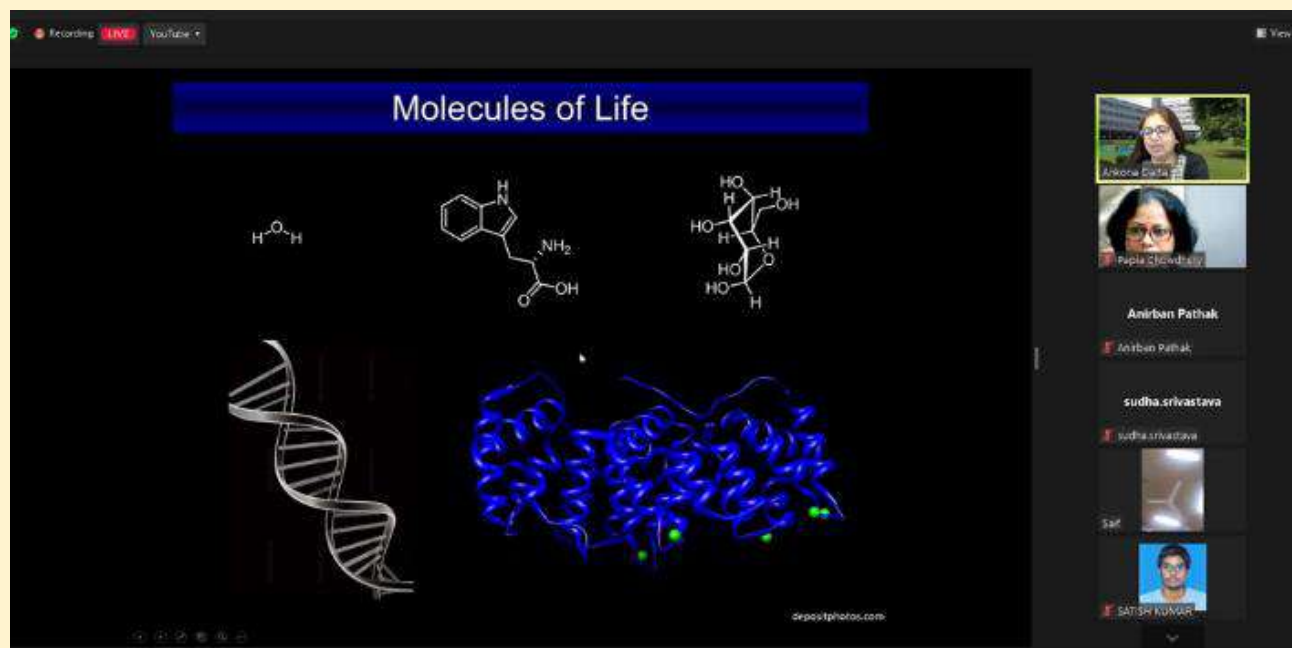
institutions where she teaches regular courses on gaseous detectors and their applications in high energy physics and in other fields like medical imaging and diagnostics, astronomy, space and PET. She also runs an NGO called Life Lab Education and Research Foundation with the main objective to create partnerships with educational institutions for the benefit of the underprivileged. Total 50 participants attended this talk.

Women in Science Lecture 7




Seventh lecture of the series was entitled “Smart Sensors Capture Life in Action” and it was delivered by Dr. Ankona Datta on 23rd September, 2022. Dr. Ankona Datta is presently working as Associate Professor in Department of Chemical Sciences at Tata Institute of Fundamental Research (TIFR), Mumbai, India. Her research interests are in broad fields of organic and inorganic chemistry with an emphasis on chemical biology and molecular imaging. In TIFR, Datta Group proposes to use a range of tools pertaining to the aforementioned fields to explore new frontiers in disease detection and to understand the fundamental molecular

mechanisms underlying disease. Specifically, her group is interested in designing and applying novel chemical probes and sensors for imaging disease markers both in vitro and in live biological samples. In her talk she started her discussion on the state of living molecules. Molecules in living systems are not static. In fact, temporal changes in molecular distribution drive essential life processes. She has discussed about the ‘smart molecular sensors’ that can capture biological molecules live in action. Total number of participants in this talk were about 50.

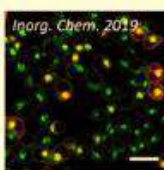


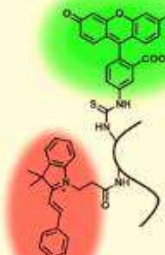
Recording **LIVE** YouTube

Chemical Probes for Sensing Applications




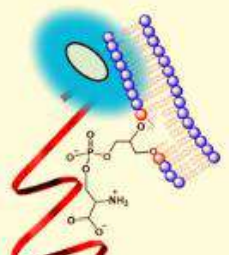
Inorg. Chem. 2019






ACS Sensors 2021






ACS Omega 2022




Ankona Datta, TIFR

View




Ankona Datta


Papia Chowdhury



Papia Chowdhury




Anirban Pathak



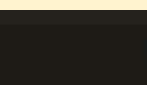
SUKANYA NASA

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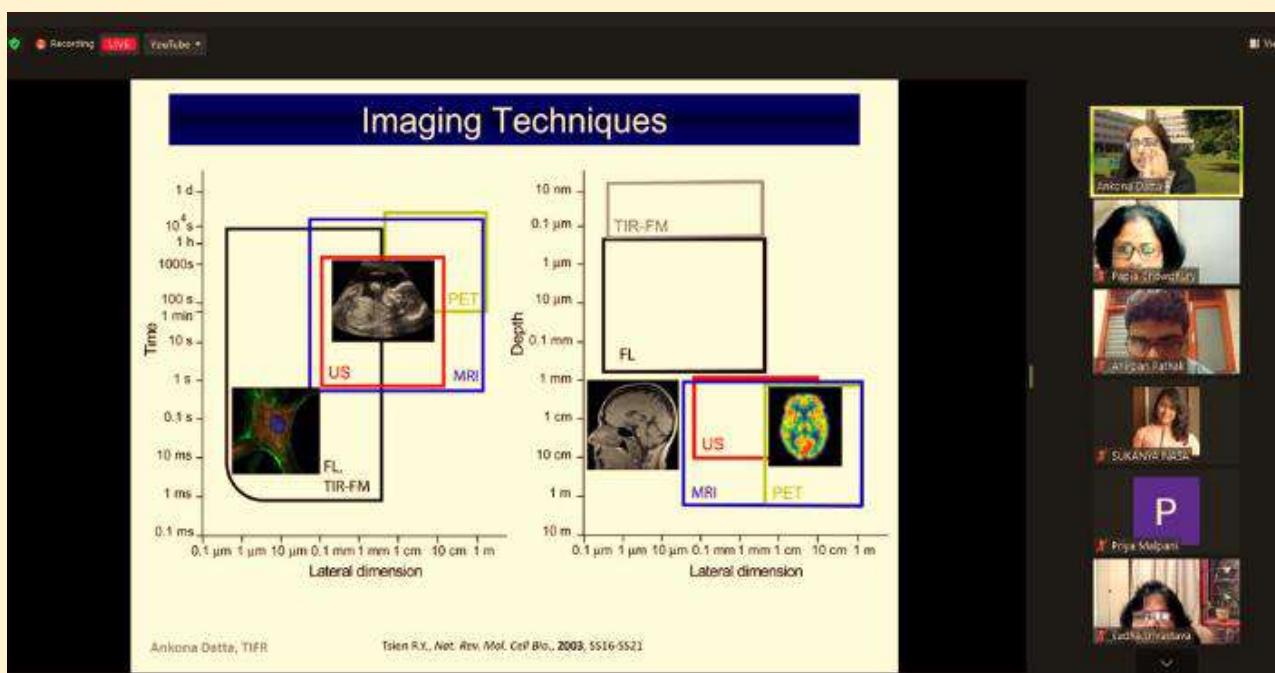


Priya Malpani

sandeep mishra



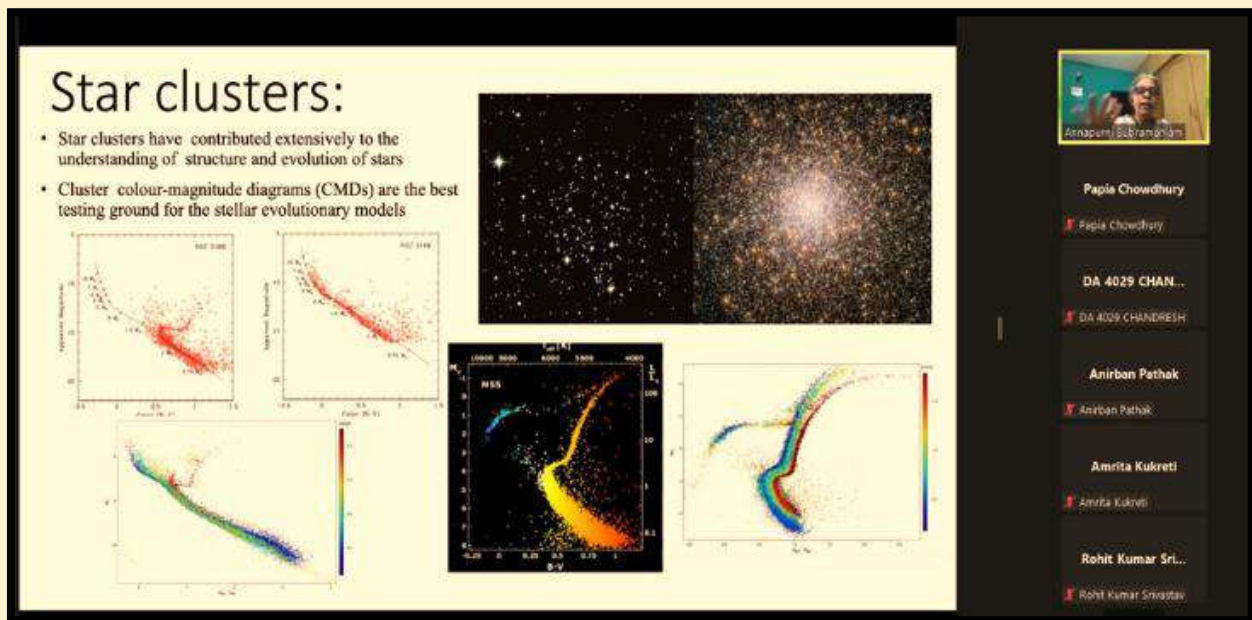
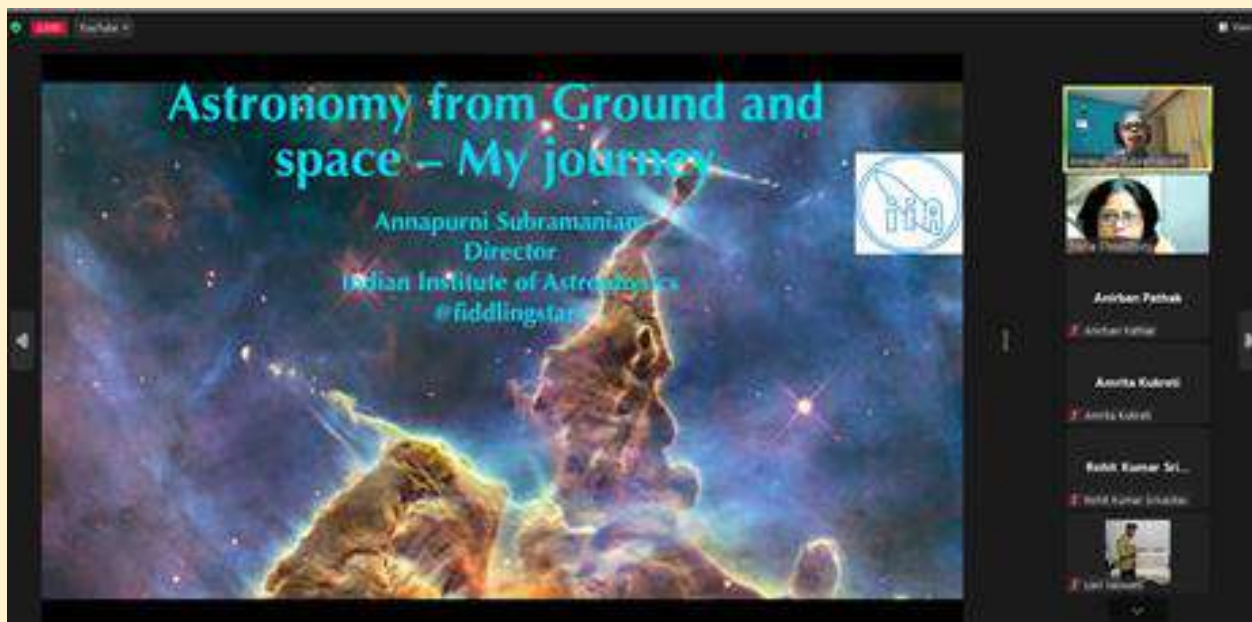
sandeep mishra



Women in Science Lecture 8



Eighth lecture of the series was delivered by Prof. Annapurni Subramaniam, currently Director of Indian Institute of Astrophysics, Bengaluru, India. The talk was delivered on September 26, 2022. She is an active member of the International Astronomical Union. Prof. Subramaniam is the elected fellow of Indian Academy of Sciences and National Academy of Sciences, India.




Her area of research includes observational astrophysics using space and ground-based telescopes, with specific interest in understanding stars in the nearby galaxies. Her major research interest includes study of stars of various masses, ages and chemical composition in nearby galaxies. She has extensively studied the nearest pair of galaxies, the Magellanic Clouds. Prof Subramaniam is also involved in India's two major astronomy projects: 1) India's first multi-wavelength astronomy satellite, ASTROSAT 2) Member of the Indian core team contributing to the proposed Thirty Meter Telescope, the next generation optical- infrared observatory to be built in Mauna Kea in Hawaii. Topic of her talk was “Astronomy from Ground and space - My journey”. Total number of participants in lecture 8 was 50


which includes faculties from various Institutes, graduate and post graduate level students from various science branches, PhD and Post Doc research scholars.

Ground based Astronomy


- in 1609, an Italian astronomer, Galileo Galilei, pointed a telescope towards the sky. It is said that he was the first to do so. With it, he saw mountains and craters on the moon.
- **Ground-Based Telescopes**
- Today, thousands of ground-based telescopes operate across the globe, with astronomers capturing new views of the universe—and new knowledge—every day.
- Ground-based telescopes have long been the workhorses of astronomical research.




2-m Himalayan Chandra Telescope
(Pic credit - Dorje Angchuk)



Magellanic Clouds: Structure formation and evolution:





2. Invited Talk by Prof. G. L. Long



The QIT group of the department of Physics and Materials Science & Engineering of IIIT, Noida organized an online talk by Prof. G. L. Long, on 14th November 2022. Prof. G. L. Long is a very well-known academician working in the area of quantum information and quantum communication with some path breaking research in the field of Quantum Secure Direct Communication. He is currently Professor at Tsinghua University, China and also working as Deputy-director at the Laboratory for Quantum Information and Measurements, Ministry of Education, China. He has published more than 300 research papers, and more than 21,000 citations with an h-index of 62. His group proposed one of

the first schemes for quantum secure direct communication and the group was first to experimentally realize the scheme. The talk was primarily focused on “Quantum Secure Direct Communication: Principles and Status”. It was a very interesting, interactive, and fruitful talk which provided a perfect platform to showcase the activities performed at Tsinghua University, China and at Jaypee Institute of information Technology, Noida

3. IIIT Student Conference on Optics and Photonics-2022 (JSCOP-2022)

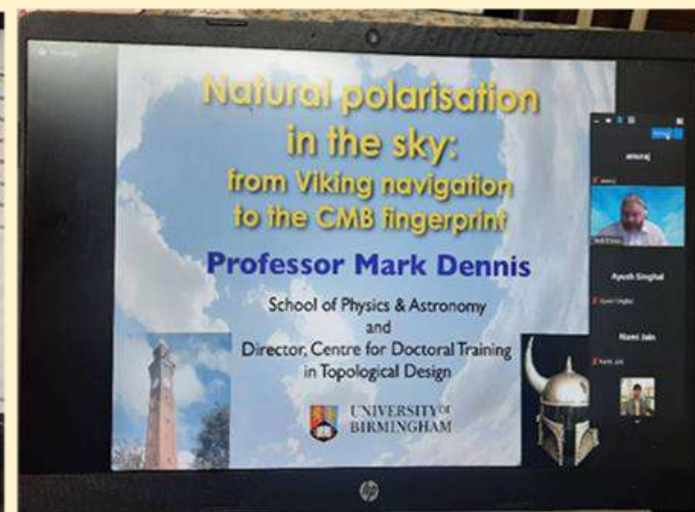
Department of Physics & Material Science & Engineering, IIIT, Noida-62 organized two days national student conference on Optics and Photonics-2022 during 7-8 May 2022. We started with online registrations from 24th April 2022. On 7th May JSCOP-4.0 started its official inauguration in the presence of Prof. Rupamanjari Ghosh, Former Vice-Chancellor of SNU, Former dean at the school of physical sciences, JNU, New Delhi, all PMSE faculties and a resplendent welcome to all the esteemed guests by IIIT Optica President, Ayush Singhal followed by the greeting from HOD, PMSE Department, Dr. Anirban Pathak and IIIT Optica Faculty Advisor, Dr. Anuraj Panwar. The energy, the anticipation

of the greater things to come was palpable in the air as was the yearning for erudition. The president of our chapter, Mr. Ayush Singhal also briefed the gathering about The Optical Society and the benefits of joining the Optica student chapter. Event was attended by 95 external and 110 internal participants. JSCOPS-4.0 comprised with five plenary talks along with contests and quiz competitions.

Plenary Talk 1 on “Role of optics in Ground-Breaking inventions” was delivered by Prof. Rupamanjari Ghosh, Former Vice-Chancellor of SNU, Former dean at the school of physical sciences, JNU, New Delhi. She also briefed her pioneering work with Prof Leonard Mandeon two-photon interference (using the nonlinear optical process of spontaneous parametric down-conversion). This work has yielded a new direction in quantum optics and quantum information, in the creation and use of a source of entangled photon pairs, and of single photons, at the forefront of research. Dr. Shailendra Kumar Varshney, Associate Professor, IIT Kharagpur presented Plenary Talk 2 on “Photonic Technologies Transforming the society and life and challenges Ahead”. The coding competition aka Bhai Lang was organized by members of IIIT-OPTICA Student Chapter. BHAIR LANG is a fun programming language written in typescript that makes coding look a lot more fun. In this coding contest, participants got a chance to work on this unique language under the guidance of our team. One quiz competition TRIVIA FALCON was organized. What makes 'Falcon Trivia!' special is that, among all the quiz and game shows out there, ours tends to encourage learning. The quiz was held in two rounds. The first round consisted of General Awareness & Science and technology topics. Participants qualifying the first round got to compete in the final round based on technical topics. Plenary Talk 3 was delivered by Prof. Mark Dennis, University of Birmingham, UK on “Natural Polarization in the sky”. His research is primarily in the physics of waves and how geometry and topology may be used to understand and controls their polarization and scattering. Last event of the day, INTERNATIONAL CODING CONTEST, the hackathon competition aka ICC, was organized by IIIT Optica chapter on online coding platform. We provided everyone an opportunity to test their coding skills and proficiency as compared to the programmers across the world. The contest was conducted in the online mode where participants got to brag their skills and compete in a fair, healthy environment.

During second day of the event, Plenary Talk 4 was delivered by Carlos Lopez-Mariscal, Underwater photonics, LLC Cozumel, Mexico on “Science Leadership skills for real-life”. Experienced Chief Scientific Officer with a demonstrated history of working in the Marine and Defense industry briefly discussed the skilled in global strategy and new business development, scientific communications and leadership, project management, and team leadership training. In Trivia falcon round 2 participants who qualified the first round got to compete in the final round based on technical topics. Plenary Talk 5 on “Career Opportunities in Tech” was presented by Mr. Navdeep Sandhu, Co-founder, Pepcoding. After that Ideathon Final Round consisted of two rounds: First-round involves your idea submission for the business model in a form of PPT.

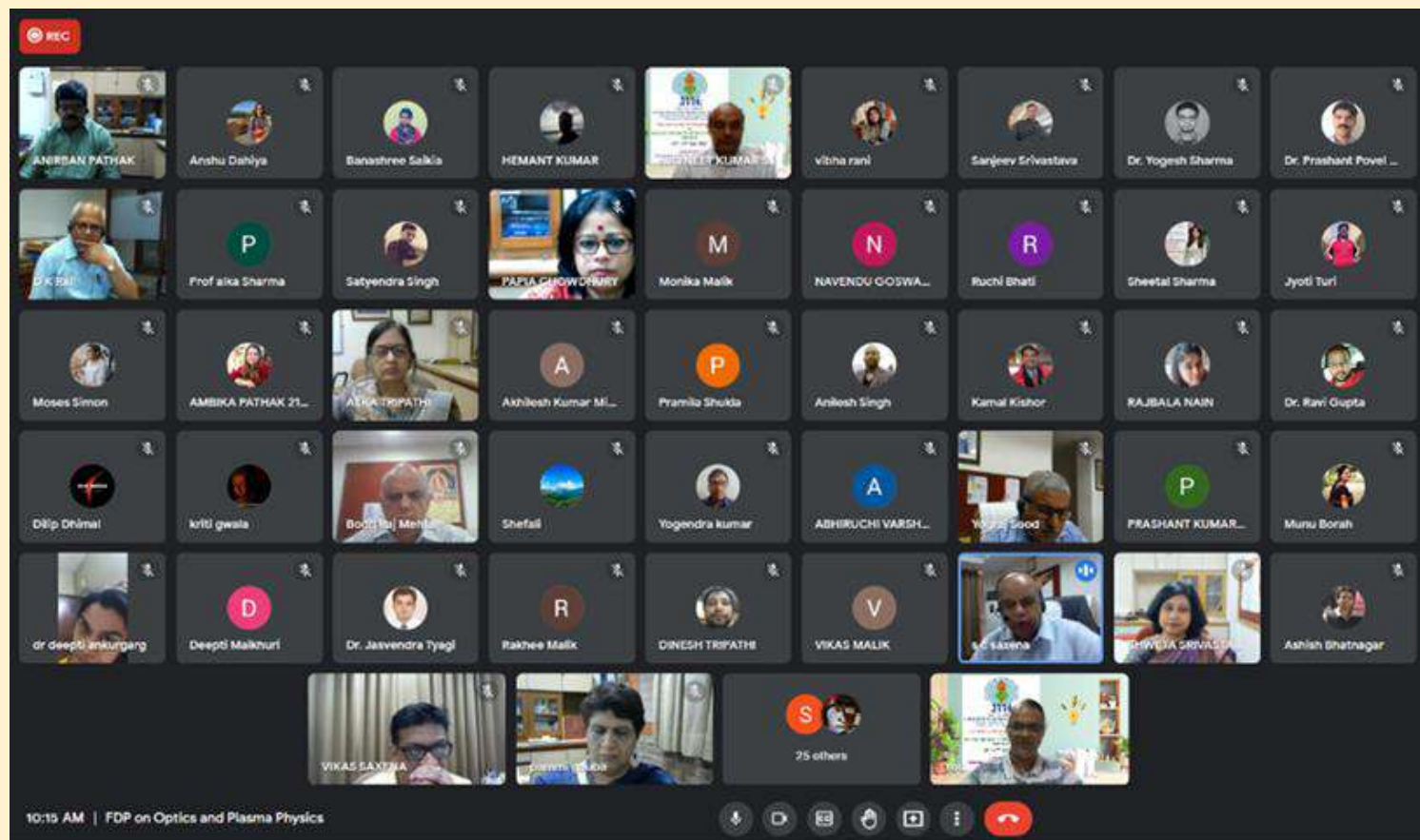




4. One-week faculty development program on Recent Trends in Optics and Plasma Physics (FDP-2022)

Department of Physics and Materials Science and Engineering organized one-week faculty development program on Recent Trends in Optics and Plasma Physics from 21st to 27th July 2022. FDP was attended by 101 external participants from premier institutes and 30 internal participants. Around, 20 expert talks by the eminent speakers from academia and industry were delivered in the FDP. Inaugural session of event was graced by the presence of Honorable Pro Chancellor Prof. S. C. Saxena, Vice Chancellor Prof. Y. R. Sood and Director Research Innovation & Development Prof. B. R. Mehta. Dean Academic & Research Prof. D. K. Rai and HoD PMSE Prof. Anirban Pathak were also present in the inaugural

function of the FDP. Prof. Navneet Kumar Sharma heartily welcomed to all the esteemed guests and participants followed. Dr. Anuraj Panwar greeted the gathering and briefed the event schedule.



Dr. Rajesh Kumar, Associate Professor, Physics Department, IIT Roorkee delivered the first talk on 21st July 2022 in the FDP. The title of his talk was Integrated hybrid silicon photonic platform for switching devices. He discussed Drude model, Joule heating by optical means and Joule heating by electrical means for losses in optical switching in detailed manner. His research interest is focused around CMOS compatible silicon photonic devices. The second talk of the day was given by Dr. Trilok Singh from IIT Kharagpur on Optical photons management in next generation thin film solar cells: From materials to device. He discussed basics of solar cells, efficiency chart and their working principles. He told that the efficiency of the thin film solar cells can be enhanced by tuning the bandgap of the semiconductors. The third talk of the day was given by Dr. Akhilesh Kumar Mishra, Assistant Professor, Department of Physics, IIT Roorkee. The topic of his talk was Metamaterials-basics and applications. He started his

talk with the basics of refractive index, Snell's law and then discussed the metamaterials principles and their applications.

On 22nd July 2022, first talk entitled, Optical fiber biosensors for environment and healthcare applications was given by Dr. Umesh Kumar Tiwari, Principal Scientist, Micro and Nano Optics Centre (μ -NOC) from CSIO Chandigarh. He started his discussion with the basics of sensors. He explained the Fiber Bragg Gratings and their applications in detail. He has published more than 100 publications in international reputed journals. The second talk of the day was delivered by Dr. Jitendra Bahadur Maurya from NIT Patna. The title of his talk was Distribution of electromagnetic fields in planar multilayer plasmonic sensor structure. He started his talk with the basics of s-polarization, p-polarization of light and reached to distribution of electromagnetic fields. He is the author of more than 35 articles. The third talk of the day was given by Mr. Hitesh Mehta. He is the co-founder of Fiber Optika Technologies Pvt Ltd and Managing Director of Eagle Photonics, a company working in the area of telecom services. He has 27 years of experience in Fiber Optic communication & Telecom industry, ranging from Production, R&D, Business Development, Project Management and consultancy. He presented the talk on fiber optic sensors. He described the fundamentals of fiber optic sensors and covered different types of available fiber optic sensors. He also showed the start-up, fiber optic sensing solutions, FO-PIDS by showing a small movie clip.

On 23rd July 2022, first talk on Dusty plasma and strongly coupled plasmas was delivered by Dr. Sanat Tiwari from IIT Jammu. He discussed strongly coupled plasma, molecular dynamics of ultra-cold plasma and Rayleigh Taylor instability simulation for strongly coupled plasma. Next talk of the day was given by Dr. Manmohan Singh Sisodia from Gautam Buddha University Noida. He discussed Design and Simulation of Nanoparticle based refractive index sensors. He told that how the sensitivity can be enhanced by using nanoparticles based refractive index sensors. The third talk was presented by Dr. Mukesh Jewariya, Senior Scientist from NPL New Delhi. The title of his talk was Terahertz: a prospectus for future in spectroscopy, imaging and quality control. He showed various methods to generate THz radiations and their applications. The fourth talk of the day was delivered by Prof. N. S. Saini of GNDU Amritsar. He discussed the Role of plasma science in research and society from. He

discussed wave dynamics, Laser-plasma interaction, nonlinear plasma dynamics and dusty plasma in great detail.

On 25th July 2022, first talk of the day was delivered by Dr. Sachin Kumar Srivastava, Assistant Professor, IIT Roorkee. The title of his talk was “Photonic nano-biosensors”. He discussed the basics of fiber optic SPR sensors and nano-biosensors. He also told about the recent developments in glucose sensor, cholesterol sensors and applications in sensing. The second talk of the day was delivered by Dr. Mukesh Jewariya, Senior Scientist from NPL New Delhi. The title of his talk was Realization of SI unit meter using laser. He discussed the advantages of SI unit meter using laser for precision length measurement. The third talk entitled, “The physics of laser-plasma accelerators” was delivered by Prof. D. N. Gupta, Department of Physics and Astrophysics, University of Delhi. He discussed laser-plasma interaction with the applications to laser wakefield acceleration, proton acceleration and electromagnetic radiation generation. He also told about the nature's accelerators. The first talk on fifth day of the FDP i.e. 26th July 2022 was delivered by Dr. Sarveshwar Sharma, Scientist E, Institute of Plasma Research, Ahmedabad. He showed his presentation entitled, Key tool for energy production and industrial applications. He told the role of plasma in energy production and industrial applications in great detail. Further, he discussed different numerical methods/ algorithms to study the sheath physics in the area of

The screenshot shows a Google Meet interface. The main window displays a presentation slide with the following content:

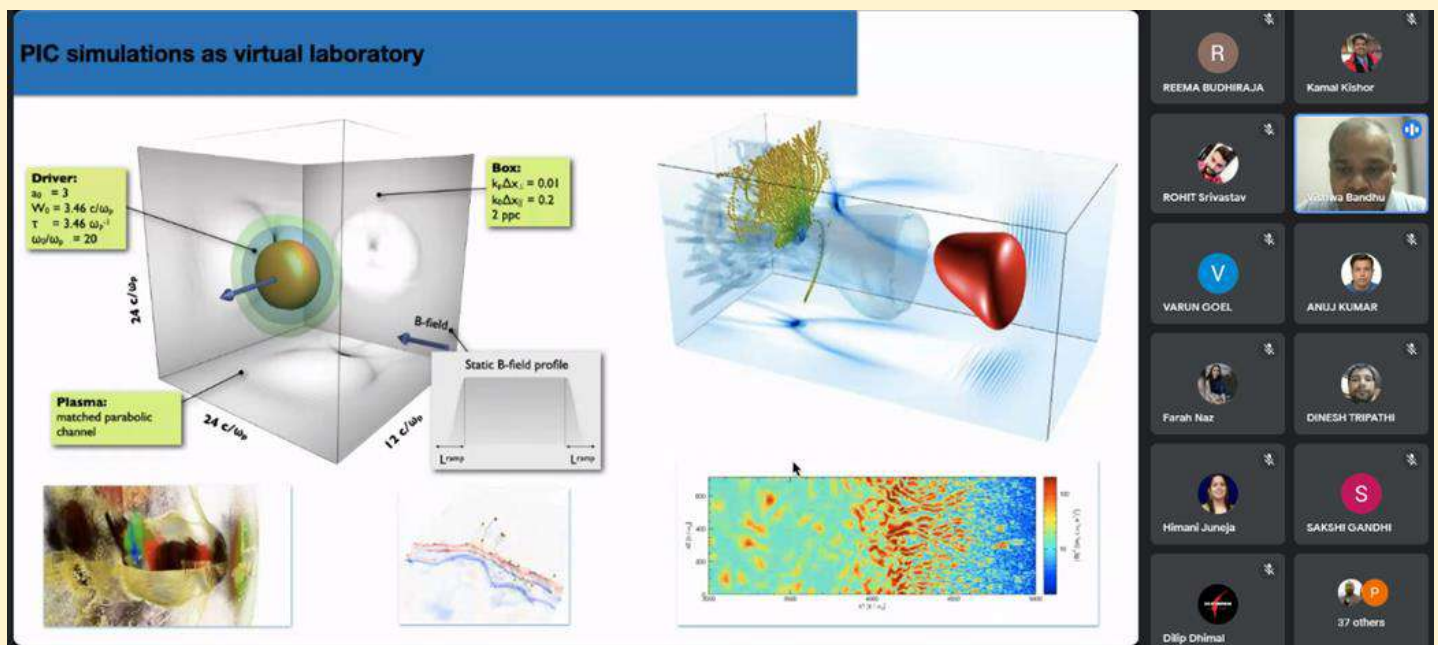
- Plasma: Key Tool for Energy Production and Industrial Applications**
- Sarveshwar Sharma**
- Basic Theory and Simulation Division,*
- Institute for Plasma Research (Dept. Of Atomic Energy),*
- Gandhinagar, Gujarat, India.*
- July 26, 2022**
- A logo featuring a stylized sun with rays and a blue 'R' inside a circle.
- At the bottom: *JAYPEE Instit...* and *gy, Noida, UP*

On the right side, a vertical list of participants is visible, each with a profile picture and name:

- Dr. Sarveshwar Sharma (top, in a larger video window)
- Dilip Dhimel
- MANOJ KUMAR
- Dr. Yogesh Sharma
- CHANDRESH KUM...
- ROHIT Srivastav

At the bottom of the screen, a status bar indicates "meet.google.com is sharing your screen." and "Stop sharing".

plasma technology for nano manufacturing, fusion machines and plasma surface interaction. The second talk of the day was given by Prof. Nitikant, Department of Physics, Lovely Professional University, Phagwara, Punjab. The title of his talk was Efficient THz generation during laser-plasma interaction. He told about the THz radiation generation and its applications. He mentioned that the THz radiation can be easily produced by using high-power laser propagation through nonlinear crystals and high-power laser propagation through plasma. He also showed the results of his important research investigations. The third talk was delivered by Dr. Shail Pandey, Assistant Professor, SVNIT Gujrat. She talked on Microwave plasma: An emerging technology for CO₂ conversion. She started her discussion with the basics of plasma and covered up to microwave plasma. She emphasized that microwave plasma is very important and an emerging technique for CO₂ conversion. The fourth and the last talk of the day was delivered by Dr. Jolly Xavier, Associate Professor, SenSE, IIT Delhi. He talked on Optoplasmonics single molecule sensor. He emphasized the role of nanophononics and plasmonics for sensing applications. He discussed cavity enhanced optoplasmonic sensors and signal conditioning, NEMS/MEMS, nanostructured solar cells and quantum photonic sensors in detail. On 27rd July 2022, the first talk of the FDP was delivered by Dr. Vishwa Bandhu Pathak, Associate Professor, VIT Vellore. The title of his talk was High-power laser plasma interaction.



He talked about the phenomenon of laser plasma interaction using relativistic self-focusing and acceleration of charged particles. He also discussed about the nonlinear plasma dynamics in presence of very high fields. The second talk of the day was delivered by Dr. Amitava Adak, Assistant Professor, Department of Physics, ISM Dhanbad. He talked upon the extreme laser plasma interactions. He emphasized on importance of extreme light sources. He also talked upon the atom under extreme light. Further, he showed the pump-probe reflectometry experimental setup of his lab.

Amitava Adak is presenting

The Extreme Laser-Plasma interactions

Amitava Adak
Assistant Professor, Department of Physics, IIT(ISM) Dhanbad

'stars' on laboratory table-top

Fusion by 'extreme light'

20

Laser wake-field acceleration

Atoms

From one extreme to another extreme

Amitava Adak

Ravi Vanshpal

Kamal Kishor

Sanjeev Srivastava

DINESH TRIPATHI

MANOJ KUMAR

The last talk on 29th July 2022 was delivered by Dr. Anindita Banerjee, Adjunct Scientist, Corporate R&D, C-DAC. The title of her talk was Quantum computing and quantum communication. She discussed quantum computing, quantum communication, quantum simulation and quantum sensing. She also explained the Quantum Mission of India regarding Quantum Computers, Quantum Circuits and Quantum Computer Simulator. After this, the FDP was finished after proposing the vote of thanks by the organizers.

Centre for Development of Advanced Computing

HYBRID QUANTUM HPC COMPUTATIONS

Hybrid is the way forward for Quantum Computing to solve grand challenging problems

Gas Handling System Dilution Refrigerator Measurement Electronics PARAM Siddhi AI

meet.google.com is sharing your screen. Stop sharing Hide

REC

4:13 PM FDP on Optics and Plasma Physics

32°C Rain off and on

16:13 29.07.2022

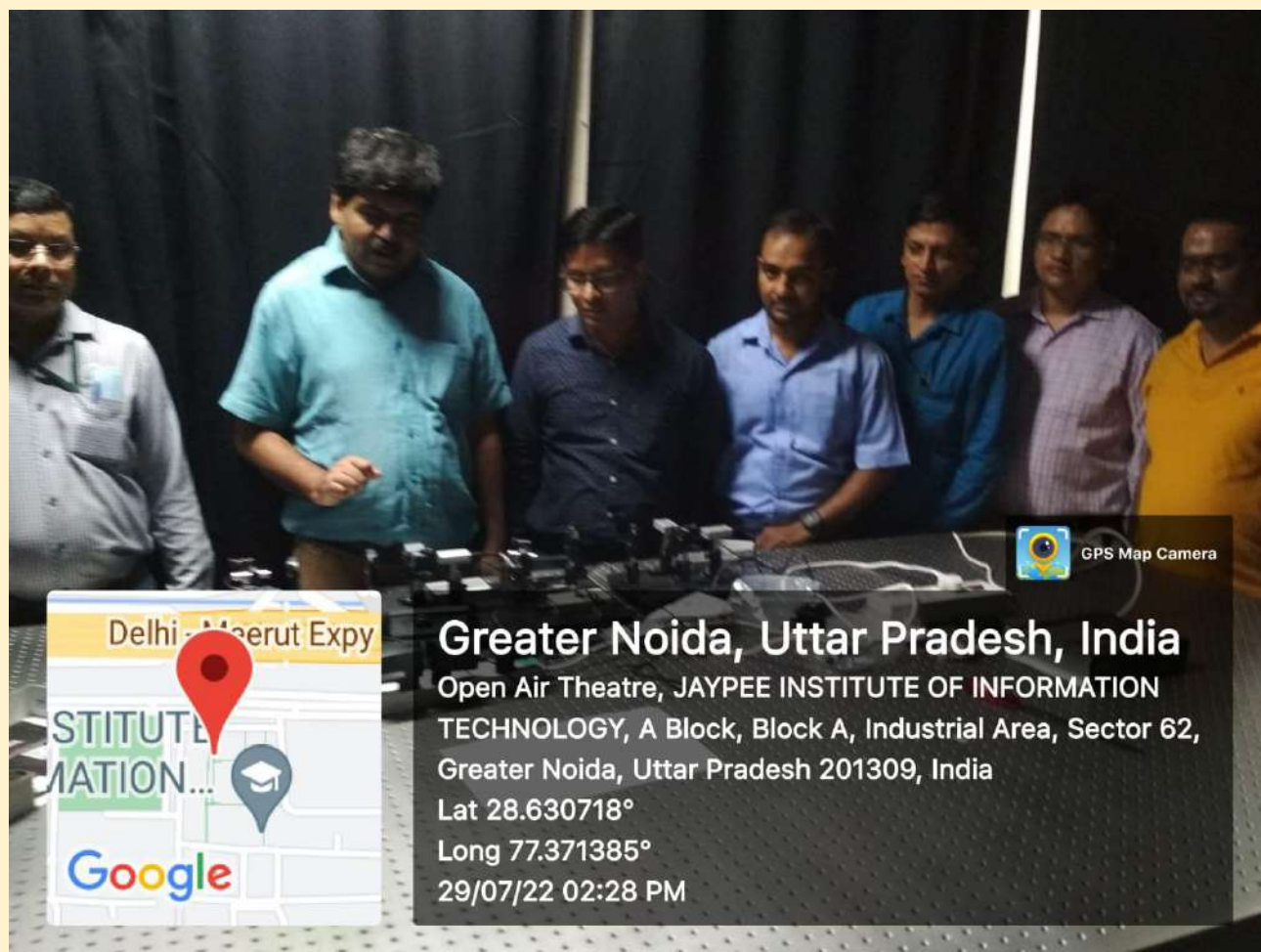
5. SDP on Fabrication and Instrumentation of Equipment used in Physics Labs

Department of Physics and Materials science and Engineering organized a SDP on Fabrication and Instrumentation of Equipment used in Physics Labs at IIIT Noida 62 from 28-07-2022 to 03-08-2022. This SDP aimed to train and educate the lab staff in order to improve their skills in handling the lab equipment's. The program was conducted in offline mode by Faculty members of Department of Physics and Materials science and Engineering, Jaypee Institute of Information Technology, Noida (U.P.), covering Fabrication of temperature controller, operation and repairing of resistive furnace, Thermal Expansion setup, Demonstration of Physics lab-1, Physics Lab-2, M.Sc. lab instruments and equipments in Material Science lab, Hand on session on fabrication and repairing of electronic devices. Program coordinators, Dr B. C. Joshi welcomed the participants in presence of Prof. Anirban Pathak, HOD PMSE and other PMSE faculty members and Dr. Dinesh Tripathi briefed about the event. Prof. Papia demonstrated the handling of equipments such as UV-Visible, FTIR etc.

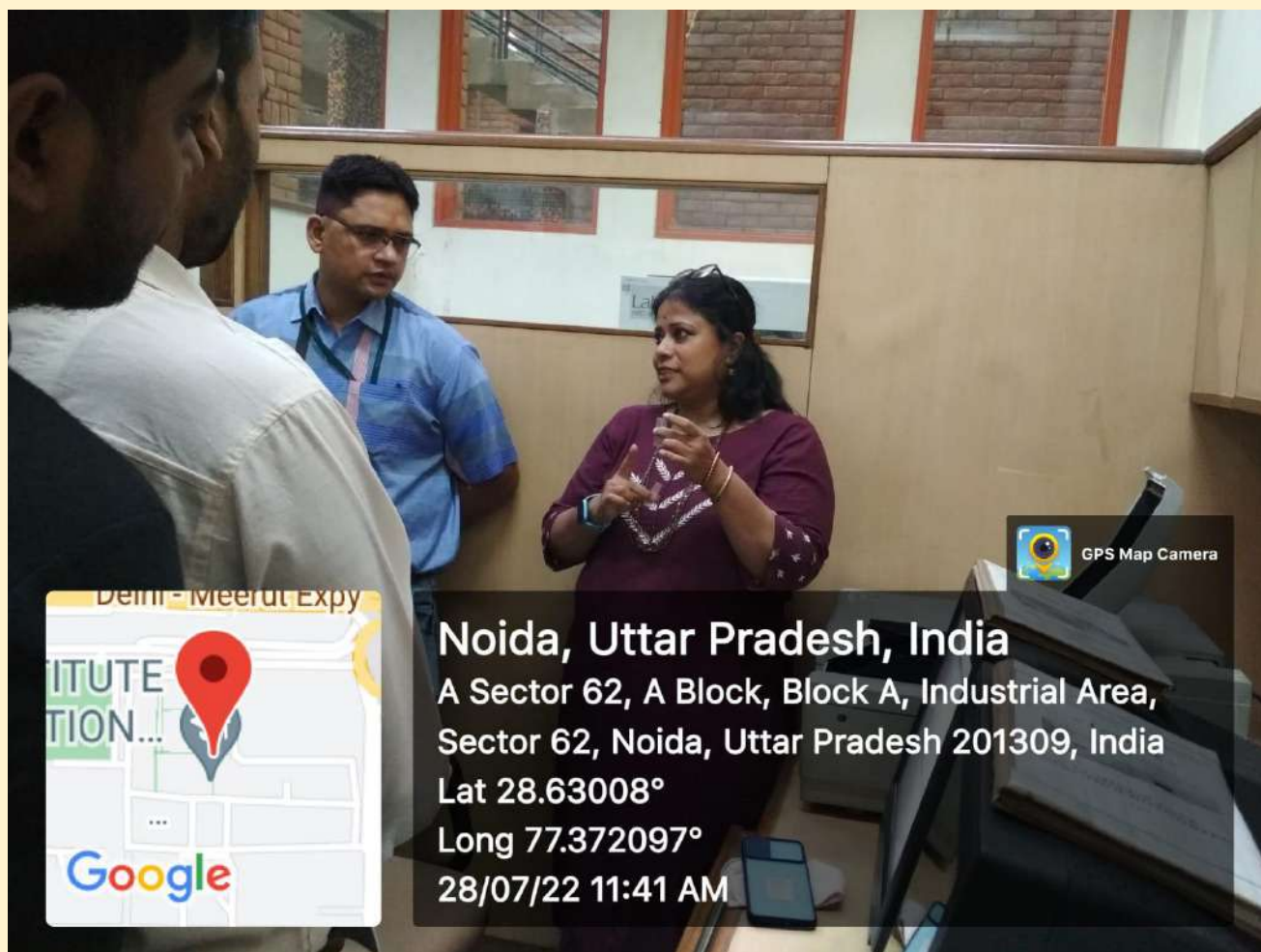




Dr. Manoj Kumar demonstrated the equipments in Material Science lab. Dr. B. C. Joshi gave the hands-on training on the use and repairing of instrument used in UG and PG Labs of the Department. Prof. Anirban Pathak discussed the introduction to quantum cryptography lab.



Dr. Ravi Gupta showed the hands-on session on fabrication and repairing of electronic devices. Dr. Dinesh Tripathi demonstrated the techniques for the fabrication of temperature controller. Dr. Ashish Bhatnagar presented the introduction to rechargeable batteries. Participants got chance to learn the fabrication, operation and repairing of resistive furnace from Dr. Manoj Tripathi. Dr. Sandeep Chhoker taught the operation of CVD. Lastly event was successfully completed with valedictory session and attended by 8 participants.



6. Invited Talk on Computational science in the age of scalable AI



Prof. Chiranjib Sur delivered an invited talk entitled “Computational science in the age of scalable AI” on 23rd November, 11:00 am, Room G4, IIIT Noida 62. Currently, he is a Senior Scientist at Shell Technology Centre, Bengaluru. Prof. Chiranjib started his professional journey as a physicist and later turned into a computer scientist. In his career spanning over more than 20 years in academia and industrial R&D, Prof Chiranjib has worked in various fields of scientific computing, applied mathematics, scalable AI, computer science and high-performance computing. Talk was

attended by 20 participants involving UG/PG students as well as few faculty members from PMSE.

7. National Science Day 2023

“National Science Day” has been organized by Physics and Materials Science and Engineering (PMSE) department under Institution Innovation Council (IIC) 5.0 QTR II of Jaypee Institute of Information Technology (JIIT), Noida on 28 February 2023. During this half day event Prof. Papia Chowdhury delivered a talk on “Raman and his effects” followed by a talk of Prof. Anirban Pathak (HOD, PMSE) on “Shaping of modern science in India: Raman and his contemporaries”. Students presented science models and posters in science exhibition. Prizes were given to top 5 presentations based on the merit of presentation. The event was attended by 73 students and 20 faculty members from PMSE and other departments.



8. Open Quantum Day 2023

Quantum scientists around the world celebrate 14th April as the World Quantum Day in commemoration of Planck constant whose value is $\sim 4.14 \times 10^{-15} \text{ eVs}$. The World Quantum Day aims at promoting the public understanding of Quantum Science and Technology around the World. In consonance with the theme, the Department of Physics and Materials Science & Engineering, IIIT, Noida is organized “Open Quantum 2023” on 14th April 2023 under the guidance of Prof. Anirban Pathak and Prof. Papiya Chowdhury. The program was specially designed for UG/PG students and teachers involved in teaching them with an aim to expose them to the recent developments in the area quantum technologies with specific attention to experimental optical quantum information and achievements. The program was sponsored by QuEST program of ICPS, Department of Science and Technology, Government of India. The program was inaugurated by the honorable Vice-Chancellor of IIIT, Prof. Bodh Raj Mehta via the generation of a random number generated by quantum random number generating device Quantis. This was followed with invited talks by the following well known experts in the domain of quantum science and technology.



Dr. Bhaskar Kanseri,
IIT, Delhi



Dr. Joyee Ghosh,
IIT, Delhi



Dr. C M Chandrashekar,
IISc, Bangalore



Prof. Anirban Pathak,
IIIT, Noida

In order to involve the UG/PG students with the current state of art in the field, the following activities were organized:

- Scientific Essay Writing (3-6 pages on any topic related to quantum technology and its applications)
- Poster Presentation (On any topic related to quantum enhanced science and technology)

- Quiz (Topic: Quantum mechanics and its applications)
- Circuit making using Qiskit

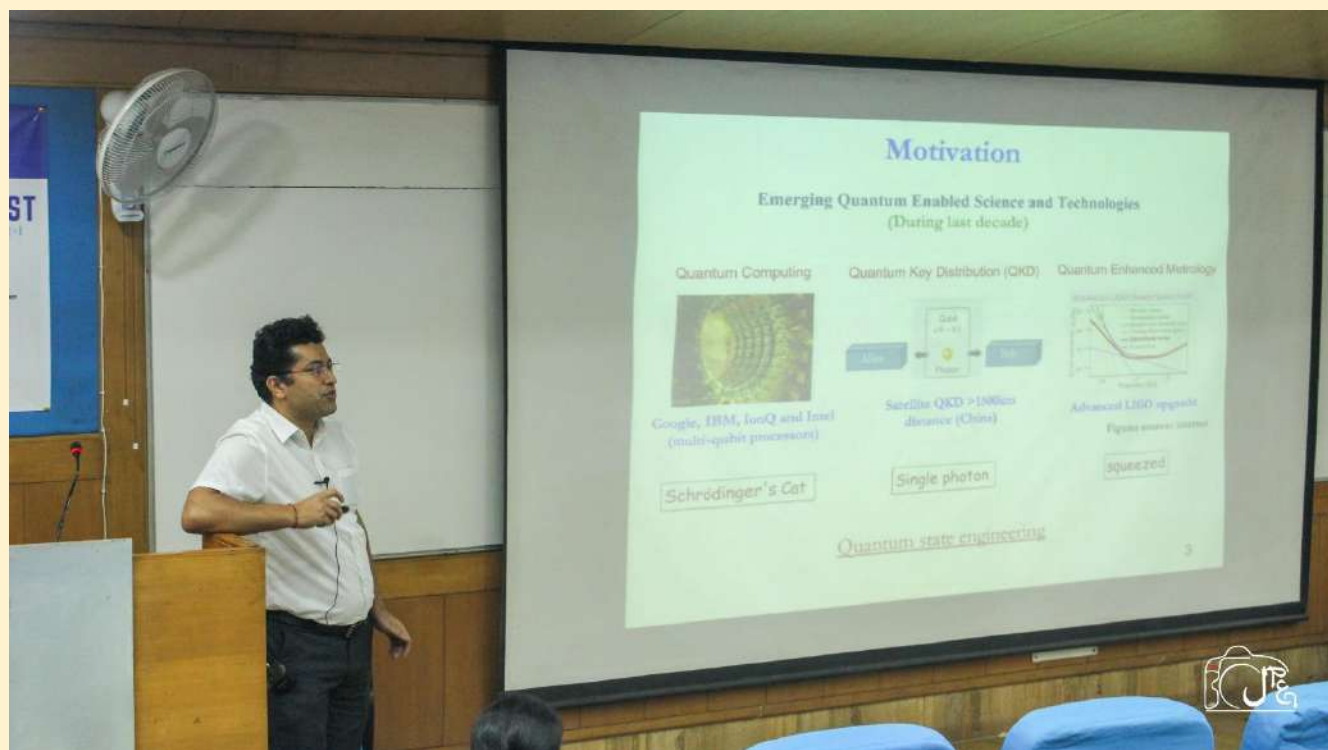
Prizes in the form of some revered books related to quantum mechanics and its applications were given to the winners and runners up in each category.

Further, a guided visit to the quantum technology-related research and teaching labs of IIIT, was organized for all the participants so as to get a hands-on experience of the current state of technology. Participants got an opportunity to see the working of basic experiments including, Franck Hertz experiment, determination of Planck's constant, Spectrometers and their applications.



Moreover, some of the following advanced experiments were also shown:

- Implementation of BB84 protocol
- Use of vibration free optical benches
- A fiber-based scheme for the implementation of quantum key distribution (specifically, COW protocol), how key rate changes with distance.
- Elitzur Vaidman Bomb testing
- Quantum random number generators



The program was a grand success with active participation of more than 75 participants involving UG/PG students as well as faculty members from nearby institutes. Moreover, the event provided a perfect platform to the students to learn about the latest activities in the emerging field of quantum science and technology.



Future Events

One-week faculty development program on “Quantum Computing and Quantum Cryptography”

(FDP-2023)

Department of Physics & Material Science & Engineering, IIIT, Noida-62 is going to organize one-week faculty development program on “Quantum Computing and Quantum Cryptography” from 17th to 21st July 2023. Primary focus of the FDP will be quantum computing and quantum communication, but important aspects of quantum materials, quantum sensing and quantum optics will also be discussed.

International Conference on Energy and Advanced Materials (ICEAM-2023)

Department of Physics & Material Science & Engineering, IIIT, Noida-62 is going to organize international conference on “on Energy and Advanced Materials” from 2nd to 4th November 2023.



Faculty Corner

स्कॉलर वो है..

स्कॉलर वो है.. जो सोच के आया था..
नोबेल रिसर्च करने को...Nature /PRL.. में पेपर छापने को.. और बेस्ट थीसिस अवार्ड पाने को...

पर आते ही फंसा था..
इंटरव्यू कमेटी के सवाल में... प्रोफेसर के भोकाल में.. और रिसर्च के जंजाल में..

स्कॉलर वो है.. जो अब लगा है..
रात ओ दिन लैब में बिताने में.. पोस्टर/प्रेजेंटेशन बनाने में...और प्रोफेसर के ट्यूटोरियल्स लेने में..

दिमाग उसका घूमा है..
थ्योरिटिकल मॉडल्स की रेटिंग में..एक्सपेरिमेंट की सेटिंग में..और पेपर की राइटिंग में..

स्कॉलर वो है...जो अब घंटों बैठा रहता है..
चाय और सुट्टा पीने में...गाइड को गरियाने में.. और खुद पे ही गुस्सा होने में...

वो अब डूबा रहता है ..
रिव्यूअर को रिप्लाई देने में..रातों जाग थीसिस लिखने में.. और रिसर्च से पीछा छुड़ाने में...

पर सोच के अब वो अक्सर पछताता है..
रिसर्च फील्ड गलत चुनने को...गाइड न बदल पाने को... रिसर्च में आ जाने को...

स्कॉलर वो है... जो बेचैन है अब..
पीएचडी की डिग्री लेने को... फॉरेन में कहीं भी पीडीऍफ़ पाने को... डॉलर में थोड़ा पैसा कमाने को...

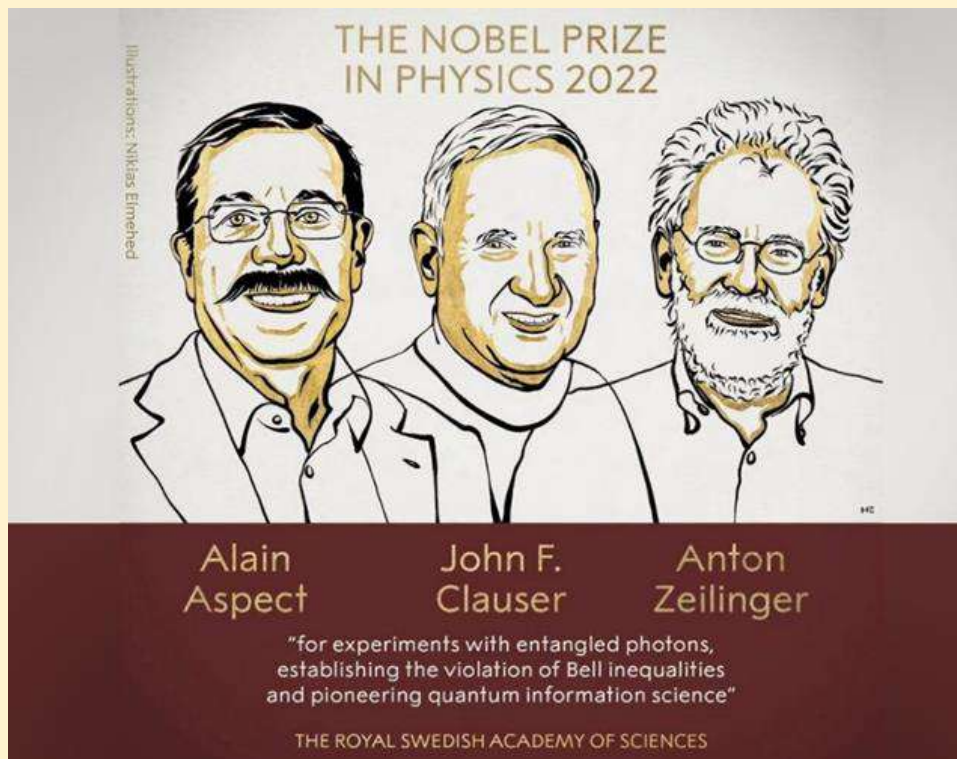
स्कॉलर वो है.. जो सोच के आया था..
नोबेल रिसर्च करने को...Nature /PRL में पेपर छापने को.. और बेस्ट थीसिस अवार्ड पाने को....,

द्वारा

डॉ प्रशांत चौहान

Paradoxical nature of reality

The Nobel Prize in Physics for the year 2022 has been awarded jointly to Alain Aspect, John F. Clauser and Anton Zeilinger “for experiments with entangled photons, establishing the violation of Bell inequalities and pioneering quantum information science”¹. Their pioneering work is in fact one of the primary reasons for the emergence of new technologies which is powering a new revolution with the emerging field of quantum computation and quantum information.



Alain Aspect, born 1947 in Agen, France. PhD 1983 from Paris-Sud University, Orsay, France. Professor at Institut d’Optique Graduate School–Université Paris-Saclay and École Polytechnique, Palaiseau, France.

John F. Clauser, born 1942 in Pasadena, CA, USA. PhD 1969 from Columbia University, New York, USA. Research Physicist, J.F. Clauser & Assoc., Walnut Creek, CA, USA.

Anton Zeilinger, born 1945 in Ried im Innkreis, Austria. PhD 1971 from University of Vienna, Austria. Professor at University of Vienna, Austria.

If we look back in time, the foundations of their work were laid at the beginning of the twentieth century when the scientific community was working overtime towards finding solutions to some of the interesting problems (blackbody radiation spectrum, stability of atoms, light is a wave or particle) which could not be explained under the framework of classical mechanics. In 1901, Max Planck² was able to explain the phenomena of blackbody radiation and introduced us to a new fundamental constant now known as Planck's constant (h). The introduction of this new constant has changed the history of physics forever. With contributions from some of the great physicists of the twentieth century such as Einstein, Schrödinger, Bohr, Heisenberg, Pauli and Dirac (just to name a few) the foundations of quantum mechanics were laid. The theory of quantum mechanics has made accurate predictions about a wide range of phenomena and has withstood the scrutiny of every experimental investigation. Further, it introduces us to new phenomena which are counter-intuitive to our classical minds. Interestingly, it is these new phenomena that offer paradigms and potential for both rich technological innovations and a window for better insights into understanding some of its deep mysteries. One such intriguing concept is the existence of entangled states. The word “entanglement” (Verschränkung in German) was first coined by Schrödinger³ who stated that “I would not call entanglement one but rather the characteristic trait of quantum mechanics, the one that enforces its entire departure from classical lines of thought”. Since then, the entanglement has been a topic of intense debate among physicists and philosophers from all over the world. Entangled particles are basically quantum particles which interacted in the past, become separated in space, and continue to remain correlated such that measuring the properties of one particle creates the possibility of knowing the properties of the other. In fact, entangled particles have been at the heart of Einstein's deep skepticism of quantum mechanics as mentioned in the EPR paradox⁴ and led to one of the most famous debates in the history of science, the Bohr-Einstein debates⁵.

Let us understand the entangled states by this simple analogy. Consider a machine that generates a pair of entangled balls and puts them in two boxes namely Box 1 and Box 2. Box 1 is given to Alice while Box 2 is given to Bob and both of them move far away from each other. The entangled balls are such that if one of them is observed to be in red color then other ball will be in blue color or vice versa. Let us assume that when the box is opened by Alice, if the ball is seen to be red

color, then Alice can be sure that Bob will be getting only blue color ball. Similarly, if Alice sees blue color ball, then Bob will be having red color ball. Naturally, a classical person will say that the machine is producing a pair of balls with one in red color while the other in blue color and then putting them in two different boxes. Balls present in each of the boxes are in a definite color, but Alice and Bob are ignorant about the color of the ball only because the balls are concealed in the boxes. So, when Alice opens the box, then the color of the ball is only revealed with balls being in definite color even before the unboxing. So, the color property of the ball represents an element of reality which is revealed when the box is opened. But, quantum entangled particles are a bit strange which is difficult to comprehend via our classical minds. If the pair of balls produced by machine are entangled particles then each of the ball will not have any definite color before the boxes are opened. So, each ball is simultaneously present in both red and blue colors before the box being opened. But, if any of the box is opened and color is observed by Alice or Bob, then somehow the colors of the ball become correlated. In fact, this strange correlation of the properties of the quantum entangled particles was at the heart of Einstein's discomfort about quantum mechanics which is detailed in the EPR paradox⁴.

So, quantum entangled particles contain some strange type of correlations which are different from classical correlations. But the question is how to differentiate between the classical and quantum correlations and identify them. In 1964, J S Bell introduced a mathematical constraint now better known as Bell's inequality⁶ which would always be valid if the measurement outcomes of two independent and separated events are classically correlated. But the Bell's inequality was mathematical in nature and very difficult to be tested in real quantum systems. In 1969, John Clauser and his colleges proposed a new form of Bell's inequality now known as CHSH inequality⁷ which is far easier to be implemented experimentally and distinguish between classical correlations and quantum correlations. The idea was to produce a pair of entangled photons which are sent in opposite directions. The polarization of each photon is measured by polarizers, the directions are whom randomly oriented. The measurement outcomes are then fed up in a coincidence counter which is then used to find the correlations. Such experiments are very difficult to perform as one has to randomly change the polarizer orientations while the photons are still in flight. Several people tried to perform this experiment including one performed by Clauser and Freedman⁸ in

1972, but they all were not loophole free. In 1982, Alan Aspect⁹ was for the first time able to perform the loophole free test for the violation of Bell's inequality in the form of CHSH inequality. CHSH inequality states that if the correlations are classical in nature, then maximum value can be 2 but the quantum correlations can go up to $2\sqrt{2}$. When the experiment was performed on entangled photons, then the violation of Bell's inequality proved that quantum correlations are stronger than classical correlations and quantum entangled systems have no classical counterpart.

The last decade of the 20th century has turned out to be very eventful when entanglement came out from the shadows of philosophical debates to eventual realization and possible applications in the field of quantum computation, unconditionally secure quantum cryptography and quantum teleportation¹⁰⁻¹¹. In fact, teleportation has been a part of many fictional stories and movies ever since the birth of civilization. Teleportation is making something disappear at one place and then making it appear at some other far-off place. The idea of teleporting the state of a quantum particle from one place to another by making use of entangled quantum particles was first proposed by Bennet *et al*¹² in 1993 and within a span of just few years in 1997, Anton Zeilinger and his colleagues were able to experimentally teleport the polarization state of a photon¹³. As of now, quantum teleportation has been successfully demonstrated over hundreds of kilometers over a range of quantum systems¹⁴⁻¹⁵. Currently, entangled states are considered to be a very important resource that be used to perform a range of tasks that are impossible using the classical devices. Currently, ongoing research is focused on taking the quantum entangled states from the laboratories to commercial applications in wide variety of applications with most important being unconditionally secure quantum communication and solving NP hard problems. Several big companies such as IBM, Google, Amazon, Toshiba, Idquantique etc. are now investing heavily for the development of commercial products. In India, National Mission on Quantum Technologies (NMQT) proposed in 2019 hopes to join this quantum revolution by developing some indigenous technologies. IIIT is also at the forefront of this great revolution with group lead by Prof. Anirban Pathak proposing various quantum cryptographic protocols by using entangled states. In fact, with the establishment of quantum cryptography lab, we have now moved into the experimental domain where work is being done to generate entangled photons and then devise practical systems for unconditionally secure communication. We all hope that the work of such great Nobel laureates

will inspire everyone to unravel the deep mysteries of nature and utilize them to develop technologies for the benefit of mankind.

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By

Dr. Sandeep Mishra

PMSE, IIIT Noida 62



Dr. Vikas Malik received 31.8 Lacs research grant from Government of India SERB on the research topic entitled “Study of realistic models of Coulomb glass system with application to nanotechnology”.

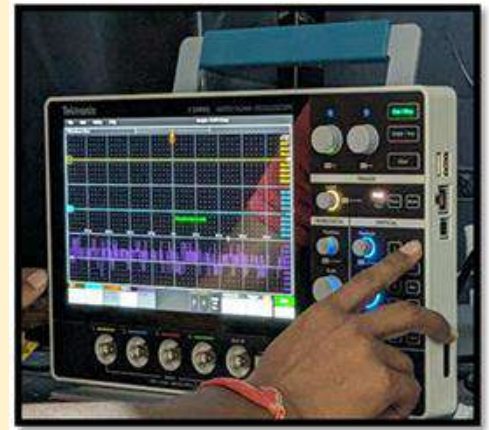
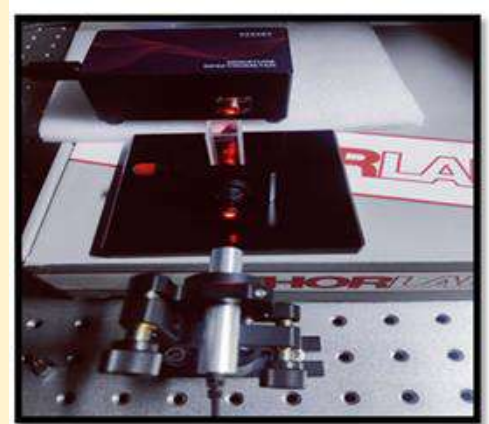
Recently added experimental facilities

Spectrometer (Model Number YIM-6001A): The spectral range of the spectrometer is 350-1050 nm. A spectrometer is basically used to measure wavelengths of electromagnetic radiation which has interacted with a sample.

Oscilloscope (Model Number MSO 24 2-BW-500): An oscilloscope is an electronic instrument that displays varying electrical voltages as a two-dimensional plot of one or more than one signals as a function of time. Oscilloscopes are used in various fields like research, engineering, medical, telecommunications industry and many more. In quantum domain oscilloscopes are very useful to observe precise signals.

Time Tagger (Model Number Time Tagger Ultra-Value Edition - Base System): In quantum-based experiments, the analysis of time correlations between the photons plays a crucial role. Time Tagger is the key component for these types of analysis.

Single photon detector (Model Number SPCM-AQRH-4): Single photon detectors define a class of photo detectors which are able to detect low intensity signals (single photon regime). They are very essential for quantum-based experiments like quantum key distribution, quantum metrology, quantum random generator etc. They operate with a reverse bias voltage above the breakdown voltage which is usually called Geiger-mode.



Student Corner

Mr. Rohit Kumar Srivastav, PhD student PMSE received Best Poster Award for his work entitled “Excitation of terahertz surface plasmon waves from the rippled graphene free-space interface” in 2nd International Conference on “Plasma Theory and Simulation (PTS-2022)” held during 20-22 June 2022 at Department of Physics, University of Lucknow, India.



Mrs. Akanska Verma, PhD student PMSE received the prize for the best oral presentation in National conference on Hydrogen Energy and Materials (NCHEAM -2023) held at Banaras Hindu University (BHU), Varanasi. Her topic of presentation was “Effect of Microwave power, radiation time and carrier gas flow on the yield of biochar obtained from the pyrolysis of mustard husk”.



Mr. Kartikey Vishwakarma, MSc Physics student PMSE received the first prize in the quantum quiz Open house event (Quantum Day -2023) organized by PMSE, IIIT Noida-62.



Mrs. Amisha Bhardwaj, MSc Physics final year student from PMSE received the best poster presentation prize in the Open house event (Quantum Day -2023) organized by PMSE, IIIT Noida-62.

PMSE Journal Club Talks

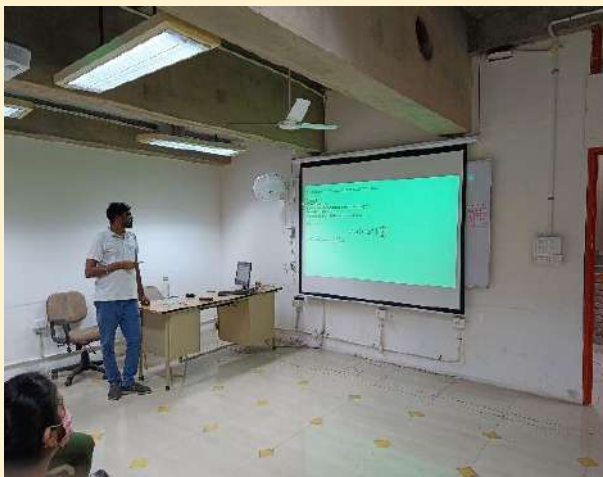
PMSE Journal Club Talk - 2

Second PMSE journal club talk was entitled with “Graphene Surface Plasmons and its applications” and was delivered by Rohit Kumar Srivastav (PMSE Research Scholars) on 31-03-22. He briefed about graphene surface plasmons for applications in sensors, communication systems, photonic devices and opto-electronic devices. Graphene surface plasmons frequency lies in the range of THz frequency regime and it may be tuned by the Fermi energy of the graphene by using the gate voltage in graphene-based devices. Number of attendees were 19 in the talk.



PMSE Journal Club Talk - 3

Third PMSE Journal Club was entitled “An Introduction to Privacy Amplification” and it was delivered by Satish Kumar (PMSE research scholar) on 16th April 2022. In principle, quantum key distribution provides us a secure key. The security of the key is ensured by Heisenberg’s uncertainty principle and no-cloning theorem. But due to imperfection in source, detector and noise in the channel, errors are introduced into the key. These errors are corrected in error correction stage. The information which has been leaked in the error correction process is taken care in the privacy amplification stage. Privacy amplification provides a secure key at the cost of reduced key size. Number of attendees were 17 in the talk.



PMSE Journal Club Talk - 4

Forth PMSE journal club talk entitled with “Studies on photo-catalytic activity in perovskites” was delivered by Ms Rajbala (PMSE research scholar) on 21st April 2022. One of the major difficulties of the twenty-first century is meeting rising global energy demand. Over 80% of the world's energy needs are currently met by burning fossil fuels, which contributes to global warming and has negative consequences for our ecosystem. Solar energy is particularly appealing because it is both clean and limitless. Photovoltaics and solar thermal energy are two of the most important ways to use solar energy. A current societal issue Photocatalysis is also used to degrade organic pigments in wastewater. Photocatalysis and photovoltaics have been discovered to benefit from a type of chemical having a perovskite-like structure (ABX_3). These materials can be employed as photocatalysts in water splitting reactions for hydrogen production and photo-degradation of organic dyes in wastewater, as well as photoanodes and light absorbers in dye-sensitized solar cells for power generation. Number of attendees were 16 in the talk.



PMSE Journal Club Talk - 5

Fifth PMSE journal club talk was entitled “X-ray Photoelectron Spectroscopy” and it was delivered by Dr. Sandeep Chhoker (PMSE Faculty) on 12th May 2022. He delivered two sessions. X-ray photoelectron spectroscopy (XPS) is a quantitative technique for measuring the elemental composition of the surface of a material, and it also determines the binding states of the elements. XPS normally probes to a depth of 10 nm-20nm. Mg ($K\alpha$) and Al ($K\alpha$) are used as source because of small line width. However, because XPS is an ultra-high vacuum technique, the sample to be analyzed has first to be evacuated. XPS has found extensive use in the investigation of textile surfaces, and this use is now spreading to the study of plasma-treated textiles. We receive the data a survey scan in terms of no of electrons per unit time with Binding energy. Talk was attended by 20 attendees.



PMSE Journal Club Talk - 6

Sixth PMSE Journal Club was entitled “A tour to Quantum cryptography lab” and it was delivered by Dr. Priya Malpani (PMSE post-doctoral fellow) on 28th August 2022. Abstract of her talk was “Due to various advantages of quantum information processing and communication, an enhanced interest on quantum information processing and quantum communication has been observed. For quantum information processing and communication, various schemes have been proposed which can be done by quantum resources only. Here the talk will be focused on the equipment available in

quantum cryptography lab such as BB84 QKD demonstration kit, Quantis random number generator and coherent one-way QKD protocol setup. The next part of the talk will be on quantum radar, how they are different from conventional radar, what is the need of quantum radar and types of quantum radar.” Number of attendees were 11 in the talk.



PMSE Journal Club Talk - 7

Seventh PMSE Journal Club was entitled “Nonlinear optical properties of Quantum dots” and it was delivered by Ms. Sukanya Nasa (PMSE research scholar) on 8th September 2022. Nonlinear optics is widely employed in a variety of applications, including laser technology, light communication,



information and image processing, storage, and optical computing. Numerous fresh potentials for nonlinear optics have emerged as a result of the swift advancement of nanoscience and nanotechnology. The upcoming nanomaterials have been shown to possess remarkable nonlinear optical properties. This encourages the creation of optoelectronic and photonic devices at the nanoscale. Since nonlinear optics

has been widely used in these areas, nonlinear optics has a great value and far-reaching scientific

significance. In this talk we will discuss Nonlinear optical properties in the terahertz region for single electron confined in spherical QD. Number of attendees were 16 in the talk.

PMSE Journal Club Talk - 8

Eighth PMSE Journal Club was entitled “Journey of James Webb Space Telescope: - Earth to Space” and it was delivered by Lavi Kumar Vaswani (PMSE research scholar) on 22nd September 2022. The James Webb Space Telescope (JWST) is a space telescope designed primarily to conduct infrared astronomy. As the largest optical telescope in space, its high infrared resolution and its novel technology in this field based upon the MIRI and NIR Cam allows it to view too early, distant, or faint objects which remain undiscovered and uncaptured by the Hubble Space Telescope. Here the talk will be focused on the manufacturing, transporting (to launch site), launch of James Webb space telescope along with its Unfolding, navigation to Lagrange point (L2) and ultimately about the images sent by JWST including covering of the astronomical aspects of spectroscopy and how they help us to explore even the minute details of this universe. Number of attendees were 13 in the talk.



PMSE Journal Club Talk - 9

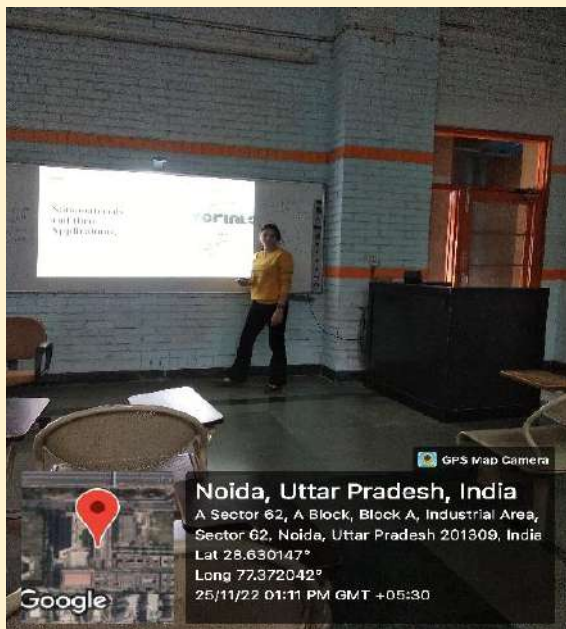
Ninth PMSE Journal Club talk was entitled “A tour of INDUS Beamlines” and it was delivered by Prateek Gupta (PMSE research scholar) on 10nd November 2022. Indus beamlines: The first Indian synchrotron radiation, INDUS-1, and INDUS-2 are electron storage rings of 450 MeV and 2 GeV beam energies respectively. Synchrotron radiation had already become well-known as a powerful

tool for basic and applied research in physics, chemistry, biology, and medicine. In this talk, we discuss the functioning and working of INDUS 1 and INDUS 2 and the availability of characterization beamlines experiments. Number of attendees were 11 in the talk.



PMSE Journal Club Talk - 10

Tenth PMSE Journal Club talk was entitled “Synthesis, Properties and application of nanomaterials” and it was delivered by Ms. Sheetal Sharma (PMSE research scholar) on 25th November 2022. The



sol-gel process is a more chemical method (wet chemical method) for the synthesis of various nanostructures, especially metal oxide nanoparticles. In this method, the molecular precursor (usually metal alkoxide) is dissolved in water or alcohol and converted to gel by heating and stirring by hydrolysis/alcoholysis. Nanomaterial can create from bottom up or top-down approaches using physical, chemical, and biological mode of synthesis. Nanotechnology is an excellent example of an emerging technology, offering engineered nanomaterials with the

great potential for producing products with substantially improved performances. Currently,

nanomaterials find commercial roles in scratch-free paints, surface coatings, electronics, cosmetics, environmental remediation, sports equipment, sensors, and energy-storage devices. Number of attendees were 12 in the talk.

Alumni Corner

JIIT PMSE Alumni Talk - 5

PMSE alumni Dr. Pradeep Kumar is currently working as a Post-Doctoral Fellow in Department of Physics, IIT BHU, Varanasi (India). He delivered a talk entitled with “Bandgap engineering and its implications” from 12 to 1pm on Saturday, 9th April 2023. Bandgap engineering plays a central role not only in the development of optoelectronic devices but also the devices with



heterostructure/interface. It is the need of the hour to tune the bandgap of material for a wide range of applications such as photovoltaics, air electrodes for batteries/fuel cells etc. In general, wide bandgap materials and typically ultra-wide bandgap materials possess the potential to improve thermo- and optoelectronic performance but a better understanding of band

structure, scattering process, electron-phonon interactions, charge transport/dynamics is required. He tried to cover the general aspect of a few works done in our laboratory with implications of bandgap engineering. He broadly works on binary/perovskite oxides/halides. ZnO is one of the well-

known wideband binary oxides with a bulk bandgap ~ 3.3 eV and our study provides a route to enhance the bandgap of ZnO in the solar-blind region. Further, the designing of 1-D photonic metamaterials using TiO₂, another wide bandgap material and reduced graphene oxide showed broad absorbance in the near-infrared regime. Recently, he has established a correlation between bandgap and electrochemical engineering in disordered LaFeO₃. In this study, his results suggest oxygen-rich La_{0.5}Sr_{0.5}FeO₃ with a reduced bandgap, high electronic conductivity, corrosion resistive catalytic behavior, and long chronopotentiometry stability, is a promising candidate for an air electrode for batteries/fuel cells.

JIIT PMSE Alumni Talk - 6

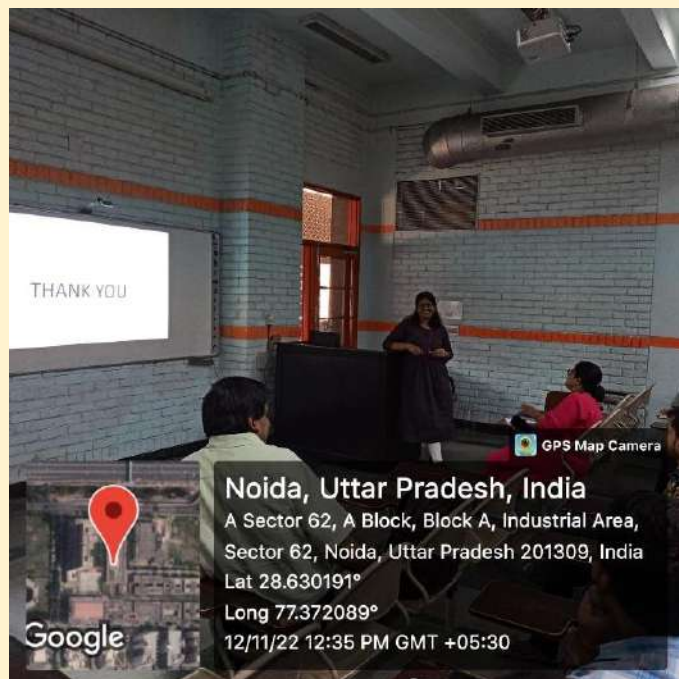
On 17th September 2023 from 12 to 1pm Dr. Himanshu Pandey from Sardar Vallabhbhai National Institute of Technology Surat delivered sixth JIIT PMSE alumni talk entitled with “Materials modeling by using Quantum Espresso”. He briefed about Heusler alloys. Heusler alloys are the class of materials that have been investigated for various applications such as spintronics, ferromagnet, superconductor, thermoelectric, energy storage, etc. Due to such a high potential, these materials are being investigated experimentally and theoretically both. Computational modeling of materials provides for examining their feasibility before their synthesis in the laboratory. In this talk, firstly he also discussed Quantum Espresso (a DFT tool) and then band structural investigations on some new



members in the family of Heusler alloys & their applications. The predicted metallic Heusler alloys can be used as electrode material in Li-based batteries whereas the semiconducting one can be in thermoelectrics.

JIIT PMSE Alumni Talk - 7

Seventh JIIT PMSE Alumni Talk was delivered by Ms. Anshul Singhal on 12 November 2022. Her talk title was entitled with “Discrimination between two coherent states using dimeric receiver”. Currently, she is pursuing PhD from Technical University of Munich, Germany. She passed MSc from PMSE department in 2021.



Recent Publications

1. Shah K., **Sharma N. K.**, “Theoretical study on fiber optic SPR sensor using indium nitride”, Indian Journal of Physics, vol. 96, pp. 275-279, 2022.
2. Al-Dossari M, **Awasthi S K**, Mohamed AM, Abd El-Gawaad NS, Sabra W, Aly AH. " Bio-Alcohol Sensor Based on One-Dimensional Photonic Crystals for Detection of Organic Materials in Wastewater." Materials, 2022;15(11):4012.
3. Pinninti Surekha, **Anshu D. Varshney**, Eunice Jerusha, Bhasker Pant, A.S. Rajesh, “Optical applications of sol-gel nano-composites,”, Materials Today: Proceedings, March 2022, ISSN 2214-7853.

4. **Awasthi S. K.**, Aly A. H., Mohamed B. ,Ameen A.,Matar Z., Mohaseb M, "Comparative study of 1D defective photonic structures composed of single and double defect layers", International Journal of Modern Physics B, 2022.
5. Matar Z.S., Al-Dossari M., **Awasthi S.K.**, Mohamed D., Abd El-Gawaad N.S., Aly A.H. "Conventional Biophotonic Sensing Approach for Sensing and Detection of Normal and Infected Samples Containing Different Blood Components." Crystals 2022, 12, 650.
6. Matar Z.S., Al-Dossari M., **Awasthi S.K.**, Abd El-Gawaad N.S., Hanafy H., Amin R.M., Fathy M.I., Aly A.H, "Theoretical Study on Polycarbonate-Based One-Dimensional Ternary Photonic Structures from Far-Ultraviolet to Near-Infrared Regions of Electromagnetic Spectrum." Crystals 2022, 12, 642.
7. Kumari N., **Varshney A.**, **Awasthi S. K.**, Shiveshwari L, Aly A. H., "Tunable photonic bandgap and reflection phase shift properties of 1D binary photonic crystal consisting of double negative and magnetic cold plasma materials", Physics of Plasmas, 2022, 29, 042110.
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10. S. Akella, K. Thapliyal, H. S. Mani, **A. Pathak**, "Dynamics of single-mode nonclassicalities and quantum correlations in the Jaynes-Cummings model", Journal of the Optical Society of America B Vol. 39, Issue 7, pp. 1829-1838 (2022).
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13. R. Joshi, A. Gupta, K. Thapliyal, R. Srikanth, and **A. Pathak**, "Hide and seek with quantum resources: new and modified protocols for quantum steganography," Quantum Information Processing, vol. 21, no. 5, pp. 1–14, April 2022

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