Department of Physics

Newsletter

Contents

About the Department

From the Dept. Head's desk

Administrative Assignments

Sanctioned Projects

Ongoing Projects Highlights

New Facilities developed

Learning augmentation

Workshops and Seminars

Publication highlights

Cover Story

Memoranda of Understanding

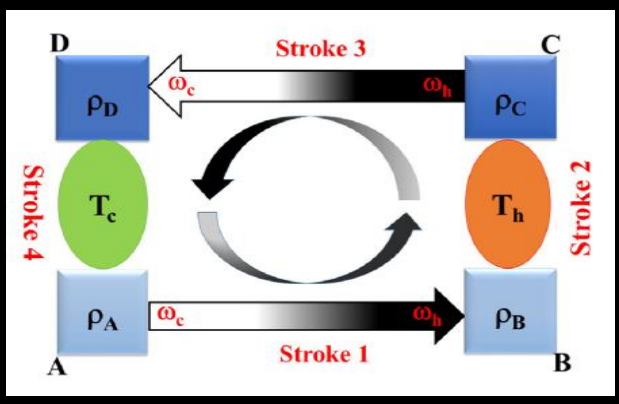
Publications

New Courses

ChalkTalks

PhD awarded and Awards & Recognitions

Students' section



Stochastic processes

The article discusses different stochastic processes that we encounter in our day-to-day activities. A simple random walk has been used as a prototype, and an overview of its applications and ramifications across different fields has been presented.

January-April 2024

About the Department

The Department of Physics, previously known as the Department of Applied Physics, since its inception in 1955 has played a pivotal role in the development and functioning of the institute. The department has also brought about accolades to the institute at several instances.

The department has a gamut of motivated, well qualified and talented faculties who are actively engaged in teaching as well as research in the areas of contemporary theoretical and experimental physics, and technology.

At present the department has 18 faculty members and around 20 research scholars. The department has been pursuing several sponsored projects funded by the UGC, DST, AICTE, BRNS, ISRO, ARDB, DRDO, NRB and CSIR.

The department has been receiving lavish fundings from prestigious funding agencies of the country as well as from the institute, owing to which it has well equipped laboratories having several advanced systems.

The ongoing academic programs in the department are the 5-year Integrated M.Sc. program, 2-year M.Sc. program and Ph.D. program. Apart from this the department provides support to the B.Tech. program of the institute by offering core and elective courses. The department also encourages its undergraduate and graduate students to undertake project in frontline areas of research. This enables prolific use of resources and helps proliferate the research culture in the young budding scientists.

from the Department Head's Desk

It is my pleasure to announce that the Department of Physics is publishing its first newsletter, for the duration January – April 2024. I wish to congratulate the team members who made it successful. The newsletter will provide a glimpse of various activities along with achievements of faculties and students. I firmly believe that the newsletter will be quite helpful in extending our vision.

It is also very heartening to see that beyond our teaching loads we could engage in several academic activities that would fetch good name for the department and I would like to raise the bar further up so that the environment in the department becomes truly vibrant, we have a sustained growth and head towards a better future.

Dr. Rajeev Kumar Sinha
Head, Department of Physics

Administrative Assignments

Dr. R. K. Sinha has been appointed Head of the Department since 1st of January, 2024.

Dr. S. Keshri, Professor and former Head, Department of Physics has been appointed Chairperson of the Internal Complaint Committee (ICC).

Dr. Rajeev Kumar has been appointed Assistant Controller of Examinations since January 2024.

Dr. D. K. Singh has been appointed Co-Convenor, Institution's Innovation Council, BIT Mesra (Jan, 2024 onwards). He is also a member of the institute IPR Cell.

Moments of pride from the recent past

Plaque of Honor for a record number of Research Publications during the academic year 2022-33 awarded to Dr S K Mukherjee by the honorable Vice Chancellor of BIT Mesra.

Dr. Rajyavardhan Ray was invited to visit the Leibniz Institute for Solid State and Materials Research (IFW) Dresden, Germany (May-July 2023) to work on **Electronic structure of tellurium based topological quantum materials**.

New Projects

Principal Investigator: Dr. Ela Rout

A New High-Performance Proton Conducting Electrolyte for Next-Generation Intermediate Temperature Fuel Cell (IT-FC)

Funding agency: Naval Research Board (NRB); Sanctioned amount: 54 Lakh

Environmentally safe and highly efficient energy conversion devices are increasingly attracting the attention of scientific community in order to meet the global energy requirement and depletion of mineral resources. Solid oxide Fuel cell (SOFC) is an alternative power generator that produces electrical energy and some heat through the electrochemical reaction between the gaseous fuels, such as hydrogen. It is considered a clean power generator due to absence of harmful emission in addition to higher energy conversion efficiency than the conventional internal combustion engines.

Conventional SOFCs using O^{2-} ion conducting electrolyte are operated at temperatures above 800°C to meet the high activation energy requirement (nearly 1eV) to conduct O^{2-} ions. However, the need for a high operating temperature leads to higher process costs and thermal degradation of materials. In recent research, more attention has been provided to reduce the operating temperature of solid oxide fuel cells (SOFC) from high (800-1000°C) to intermediate temperature range (400-800°C) to realize the commercialization of SOFC in a broader market. Replacing electrolyte materials from conventional oxide ion (O^{2-}) conductors to proton (H^{+}) conductors is one of the most promising approaches to reduce the operating temperature.

Hence, the development and optimization of a novel or improved electrolyte for intermediate temperature proton conducting SOFC application to replace the current proton conductors is the motivation of the proposed research.

Hafnium Loaded Proton Conducting Oxide for Direct-Hydrocarbon Intermediate Temperature Solid Oxide Fuel Cell Application

Funding agency: SERB, DST; Sanctioned amount: 47 lakh

Eco-friendly and fuel flexible energy conversion by SOFCs has immensely captivated the curiosity of diverse researchers in the pursuit of sustainability and green energy conversion. While high operating temperature demands for O^{2-} conduction with high activation barrier (~ 1 eV) invites technical and economical adversity. Direct-hydrocarbon SOFCs are the footsteps to smart and advanced electrochemical technology which forbids fuel processor. The afore-unit coupled into power grids uplifts the energy conversion efficiency and eliminates toxic effluents. The catalysis by steam reforming fuel electrode (anode) is vital for charge transfer and the overall cell performance.

Currently, the YSZ-Ni cermet is a commercial anode, however, Ni based anodes suffer coking and sulfur poisoning and carbon deposition against carbonaceous fuel. This reduces the fuel utilization and power output of the fuel cell under hydrocarbon fuels. Therefore, the current motivation of work involves the material insights to accomplish a catalytically active robust direct-hydrocarbon SOFCs at intermediate operating temperatures to aid coking and Sulphur-tolerant with desirable chemical inertness.

Ongoing Project Highlights

Principal Investigator: Dr. Anupam Roy

Exploring Resistive Random Access Memory Devices based on Two-Dimensional Materials for Non-Volatile Memory Applications

Funding agency: SERB-SRG, DST; Sanctioned amount: 32.12 lakh.

In today's digital era, the role of memory technology has become very crucial, particularly in the context of artificial intelligence (AI) applications. For example, several AI tasks heavily depend on memory storage and processing capability of the related hardware. However, conventional memory technologies do not meet the energy requirement for implementing these data-intensive applications due to their volatile nature, resulting in power dissipation. In this context, an ultra-fast non-volatile memory (NVM) is necessary to effectively harness and utilize its full potential. Among several emerging NVM technologies, Resistive Random-Access Memory (RRAM) devices show significant promise because of their small footprint, faster speed of operation, and low power consumption, *etc.*

RRAM devices based on high dielectric constant transition metal oxide (TMO) show high on/off ratios and fast switching times, however, requirement of higher voltages to switch between the memory states is not desirable. Use of two-dimensional (2D) materials recently flourished following the prediction of several shortcomings of TMO-based RRAM. In this project, the possibilities of using 2D materials as the alternating material by addressing the issues related to TMO-based RRAM devices.

Ongoing Project Highlights

Principal Investigator: Dr. Rajyavardhan Ray

Magnetic excitations and crystal field effects in the honeycomb quantum antiferromagnets: Application to RCl_3 (R=rare earths)

Funding agency: SERB-SRG, DST; Sanctioned amount: 19.91 lakh.

Quantum spin liquids (QSLs) are novel states of matter that cannot be described via the conventional order parameter associated with spontaneous symmetry breaking. Search for potential materials, thus lie at the forefront of current condensed matter research from fundamental as well as application viewpoints. To that end, while the honeycomb lattice magnets with anisotropic bond-dependent magnetic interactions --- the so called Kitaev exchange interactions, such as in α-$RuCl_3$, are important, the large coordination number ratio of nearest-neighbors to next-nearest neighbors makes the isotropic honeycomb lattice quantum antiferromagnets (HQAFs) especially susceptible to frustration effects.

The project focuses on the magnetic properties of rare-earth HQAF, RCl_3 (R: rare earths) isostructural to α-$RuCl_3$ where a QSL-like phase under magnetic field has been predicted and observed experimentally. In comparison, early experiments on the recently synthesized $YbCl_3$, however, found that the ground state is a Neel antiferromagnet (NAF) of effective S=1/2 Yb^{3+} ions with a possible short-range magnetic ordered state with bond-dependent magnetic anisotropy (as in α-$RuCl_3$). The inelastic neutron scattering data for the magnon spectra, on the other hand, suggests a low-energy model consisting of only the nearest-neighbor isotropic Heisenberg interaction between S=1/2. The competing magnetic interactions due to extended range coupling even for isotropic HQAFs may lead to dramatic features such as roton-like structure in the magnon spectra, deconfinement criticality, or even a QSL state. HQAFs have been theoretically investigated using a variety of tools and a QSL has been predicted in many cases. Nevertheless, both the existence as well as the nature of the possible QSL state remains controversial.

New Facilities developed

RF sputtering for coating on ball bearings components developed by Dr Rishi Sharma

- A 300-watt RF (13.56 MHz)
- Rectangular vacuum chamber with an opening from the front to load the samples. With a quartz window attached to the front door to monitor the process.
- A pumping system comprising of oil diffusion pump, and a rotary vane pump, with two Pirani gauges and one penning gauge attached for monitoring the pressure.
- A rectangular magnetron gun is attached to one side, and an arrangement for the rotation of bearing balls, inner and outer races, is attached on the counter side.
- Two Mass Flow Controllers of 0 – 100 sccm flow rate adjustments.

The system is specifically designed for developing coatings on all components of ball bearings.

Two-heating-zone chemical vapor deposition developed by Dr Anupam Roy

Two-heating-zone chemical vapor deposition (CVD) system (Ants Innovation Pvt. Ltd.) is created by Dr. Anupam Roy under the SERB-DST project.

The system is designed to achieve a maximum temperature of 1050°C and each zone is equipped with a separate programmable temperature controller. The growth is conducted inside a replaceable quartz tube and under carrier gases, $N_2/Ar/H_2$. The gas flow can be regulated by a mass flow controller (MFC). This system can be used to grow various 2D materials, e.g., MoS_2, WS_2, *etc.*

New Facilities developed

Low temperature decantation setup developed by Dr. S K Mukherjee

The low-temperature decantation setup. With the help of this device, we were able to reduce the average decantation time (separating glycerol from biodiesel) from 24 hours to 30 minutes (depending on temperature), thereby, speeding up the biodiesel production process.
The separation could be easily seen in the photographs where the lower layer is glycerol while the upper one is biodiesel.
The machine for the esterification and transesterification processes involved in biodiesel production is still under fabrication and is presently in the Mechanical Engineering Department.

High Vacuum Annealing Furnace System

Annealing process is an important part of thin film growth. Thin film materials require high temperature for crystallization in high vacuum environment. For this purpose, we have developed HVAFS (High Vacuum Annealing Furnace System) in the Plasma Lab, of our department. This system is mounted on a DC sputtering system with diffusion pump.

Thin film samples inside the chamber on sample stage holder.

Copper pipe surrounding the heating chamber for cooling

(b)

Heater placed inside the vacuum chamber

The system is capable of attaining 600 °C with pressure below 5×10^{-5} mbar within 30 minutes. To keep the chamber cool, copper pipe is wrapped and connected to the chiller pump. The sample holder is designed to hold as many as 20 samples (2 × 2 cm size) at a time.

Learning augmentation

Workshop on "Advances in Photonics and Spectroscopy" was conducted from 11-15 March 2024. The workshop had six resource persons Prof. P. K. Das (IISc), Prof. T. Kundu (IIT Bombay), Prof. D. Narayana Rao (UoHyd), Prof. P. K. Datta (IIT KGP), Prof. M. E. Crestoni (University of Rome "La Sapienza") and Dr. R. Poddar (BIT Mesra). The workshop was attended by 29 participants from M.Sc., I.M.Sc. and Ph.D. Various topics of Photonics and Spectroscopy were discussed during the workshop.

BIT @ LHC

Dr. Ram Krishna Dewanjee was invited as a panelist to attend the conference: **Future Topics in Collider Physics (FTCP-2024)** which was held at IISER Pune from Feb 14th to 17th 2024. This conference was held to discuss future Indian contributions to the CMS experiment at the LHC CERN. Panel discussions were held on topics related to both theoretical and experimental particle physics by leading experts in the field.

Workshops and Seminars

Prof. S. Keshri was invited as resource person of 13th Vidyasagar Satyendra Nath Bose National Workshop on **Emerging Fields in Theoretical and Experimental Physics (EFTEP-2024)**, during 5th March to 7th March 2024, organized by Vidyasagar University, Medinipur, West Bengal.

Dr. D K Singh delivered invited talks on three different events:

Nanoscale Devices at the Short-Term Training Program on Microelectronics & VLSI Design (MVD-2024) organized by the Department of Electronics and Communication Engineering, BIT Mesra, during 2nd to 6th April, 2024.

Intricacies, Art and Mathematical Modelling: A Tightrope Walker's Balance for Scientific Reporting at the 6-days National Level Advanced Faculty Development Programme (Hybrid Mode) on "Academic Ethics and Scientific Writing", organized by the IPR CELL, AJU & IQAC CELL, Arka Jain University, Jamshedpur, during 18th to 23rd March, 2024.

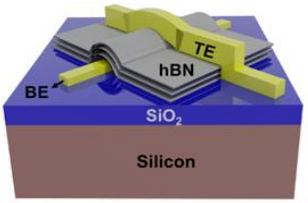
Engineering Atomically Thin Semiconductors (MoS_2 and WS_2) based Photodetectors with High Responsivity at the International Conference on Advances in Novel Materials: Towards Sustainable Future" (ICAN-24) January 2024, organized by the St. Xavier's College, Ranchi, during 20th to 22th January, 2024.

Dr. Ram Krishna Dewanjee was invited as a discussion leader in Working Group-1 (WG1) focusing on Standard Model & Beyond Standard Model Physics at the **Workshop on High Energy and Particle Physics (WHEPP-2023)** held at IIT Gandhinagar from Jan 2nd to 11th 2024. This working group focused on Higgs boson coupling measurements at both current (14 TeV Large Hadron Collider) and future particle accelerators (e.g. 100 TeV Future Circular Collider) Emphasis was made on the expected uncertainties on these couplings and their sensitivity towards new beyond standard model physics.

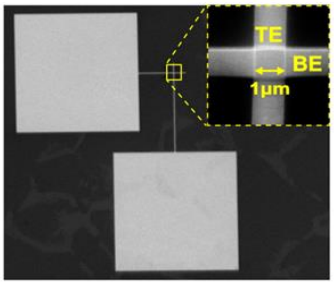
Mrs. Kirti Sharma working under the supervision of Dr P K Tiwari, presented a paper titled **Machine Learning: A crucial tool in the characterization of Quantum Dots** at the 3rd Edition International Conference on Physics and Quantum Physics, Barcelona, Spain held during March 25-26, 2024.

Publication Highlights

SST Nibhanupudi, **Anupam Roy**, *et al.*, *Ultra-fast switching memristors based on two-dimensional materials*, Nature Communications **15**, 2334 (2024) [Impact Factor: 16.6].



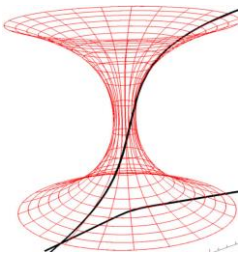
The potential to reduce the thickness of two-dimensional (2D) materials to a single monolayer opens up an exciting opportunity for the development of high-speed, energy-efficient memristors. In this article, we report an ultra-fast memristor fabricated using atomically thin sheets of 2D hexagonal Boron Nitride (h-BN), exhibiting the **shortest** observed switching speed (120 ps) among 2D memristors and low switching energy (2pJ). This study unveils the potential of 2D memristors for future computing, storage, and RF applications.

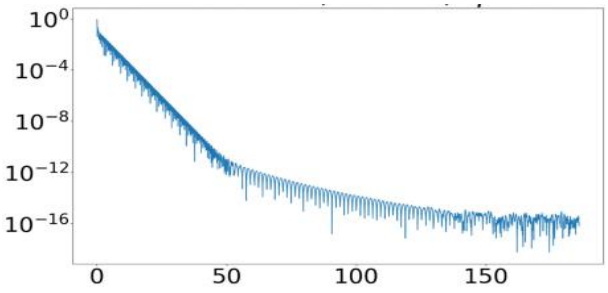


Publication Highlights

Antariksha Mitra and **Suman Ghosh**, *Signature quasinormal modes of Ellis-Bronnikov wormhole embedded in warped braneworld background,* Phys. Rev. D **109**, 064005 (2024) [Impact Factor: 5.0]

Damped oscillation of any dissipative system, for example, a black hole under perturbation can be expressed in terms of Quasi-Normal Modes (QNM). Every black-hole could be a potential wormhole as well. While studying characteristic QNMs of a specific class of wormholes in a five-dimensional universe, we found that the signature of the extra dimension shows up as two distinct quasinormal-decay eras, characterized by two distinct dominant quasinormal modes. This result is a first of its kind and, with the beginning of precision cosmology and 'black-hole photography', could be useful in detection of exotic objects of aforementioned type if they indeed exist!





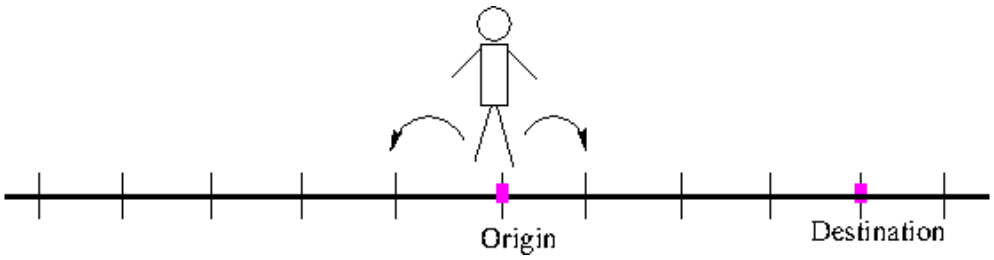
Cover Story

Stochastic processes

Let us start by categorizing any natural process under either of the two headings: *deterministic* and *stochastic*. If the initial state of a system gives away its entire subsequent evolution under the given constraints, it undergoes deterministic evolution, and its fate is sealed. Prominent examples are the Newton's laws or equivalently the Hamiltonian dynamics, relativistic mechanics, Maxwell's equations, Schrodinger's equation, etc. The intrinsic randomness occurring in quantum mechanics will not be a part of this discourse.

What are the examples of deterministic processes in nature? To be precise, nothing! Since no system exists precisely at absolute zero or can be completely isolated from its environment, we can safely say that all natural processes involve stochasticity to some extent. To a very good approximation, the dynamics of a massive body is deterministic, since its thermal energy can be ignored for all intents and purposes. Nevertheless, in a general setting, it is randomness that rules the roost in subjects as diverse as natural sciences, graph theory, game theory, foraging techniques, network theory and finance. Even the sequence of activities of a human being in a day, under the same external conditions, is substantially random.

To begin with, consider the random walk problem in physics. Let's discuss the one-dimensional case for simplicity: a man is left with the task of finding his way home. He has somehow lost his sense of reason, and is likely to take a step either towards left or towards right. How long would he take to reach his destination for the first time? The time required is called the first passage time. The concept is often exemplified by the famous Gambler's ruin problem, where two gamblers keep playing till one of them loses all his money. There are numerous other applications. Random walk statistics finds its applications in search algorithms, financial market analysis, diffusion phenomena, exclusion processes, aggregation-fragmentation models, spin dynamics, and many other spheres.



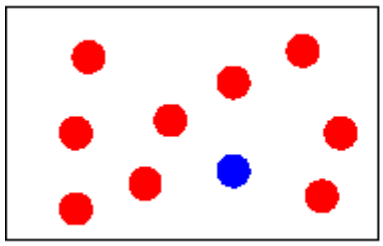
Example of a random walk

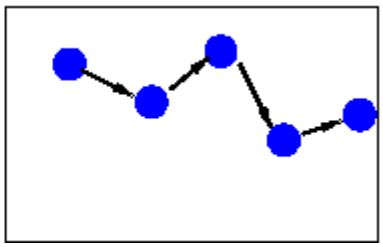
Now allow the random walker's steps become small enough for his position to be safely represented by a continuous variable. In this limit, we obtain the well-known dynamics of Brownian motion[1], whose theoretical foundations were established by Einstein in 1905 and independently by Smoluchowski in 1906.

[1]The first systematic observations of the motion are credited to Robert Brown, who studied the dynamics of tiny organelles (possibly amyloplasts), ejected by pollen grains, suspended in water.

contd.

Think of a box of ideal gas at equilibrium. *Macroscopically*, nothing happens, and the evolution of the state, or the lack thereof, is deterministic (left figure). Now focus on any *one* of the particles (say the blue one) and observe how its *microstate* evolves. This will give rise to a sequence of microstates over the time of observation, each being almost certainly different from another (right figure). Even though the *macro*states (or thermodynamic states) are same, the *micro*states are not. The latter, in fact, *appears to* follow a stochastic trajectory, but that simply stems from the fact that we are oblivious to its interactions with other particles. It is like the apparent random steps of a person navigating a crowd, where somehow the crowd has disappeared from our view.





A typical stochastic trajectory

Now make the blue particle much bigger, say of the order of hundreds of nanometres, so that it can be observed under a microscope. It then becomes an ideal candidate for being a Brownian particle, among the red molecules of the surrounding fluid. Believe it or not, even now the concerned particle is not large enough to be immune to the effects of the bombarding molecules! Like a floating pumpkin being jiggled around incessantly in a sea of sprightly mustard seeds, the Brownian particle gets tossed around due to the thermal motion of the surrounding molecules.

Recent years have observed vertiginous developments in the manipulations of nanoscale objects, and actual heat engines have been produced that work at such scales. In this world of minuscule inhabitants, thermal motion plays a dominant role. Accordingly, these microscopic engines are termed "Stochastic Heat Engines". Needless to say, the designs of such engines are necessarily very different from their macroscopic counterparts. Their major usage would be in the running of microscopic machines. Although they are still in their nascent stage, they have been hailed as the harbingers of a prospective revolution in the medical industry.

The story then boils down to a tussle between randomness and determinism, and nature seems to favour phenomena that incorporate some degree of both[1]. Determinism makes a process easier to understand and allows absolute predictability. Nevertheless, we would agree that it is stochasticity that makes life far more interesting and imparts enough richness to various events to keep us motivated towards unravelling their mysteries.

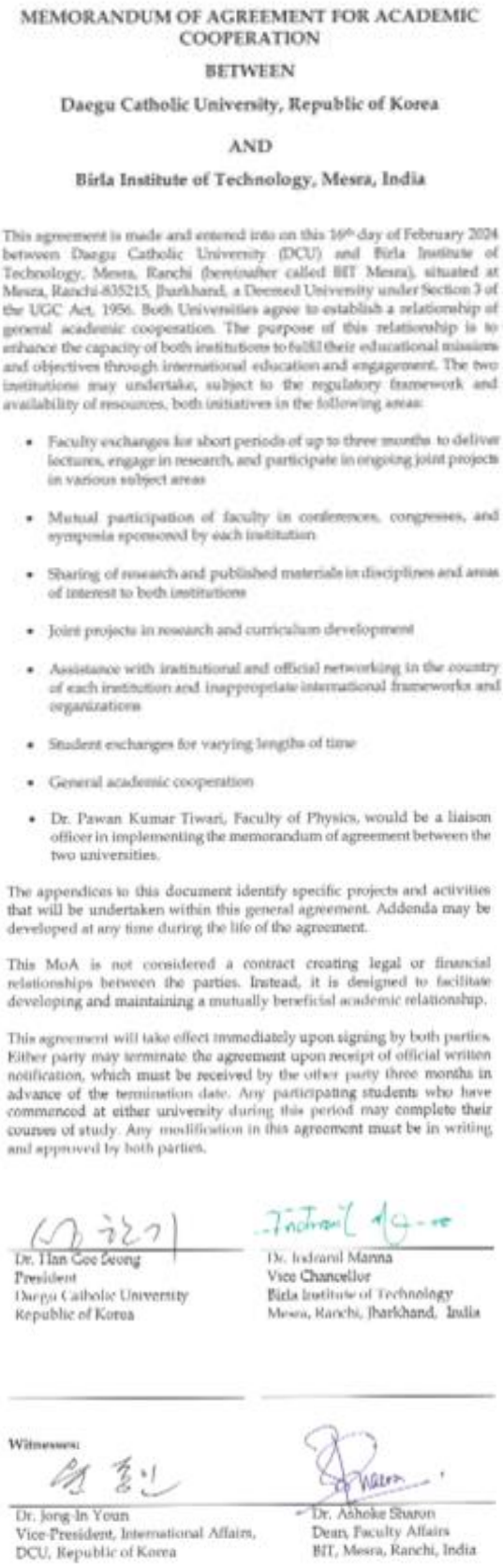
[1]Conceive of a Brownian particle in a flowing stream of water. The stochasticity is still present, but on top of it there is a deterministic drag in the direction of the flow.

Memorandum of Agreement

A Memorandum of Agreement was signed between the Daegu Catholic University, Rep. of Korea and the Birla Institute of Technology, Mesra, on the 21st of February 2024. The Vice-Chancellor signed the document for the institute. Dr. P K Tiwari, Dept. Of Physics, BIT Mesra acted as Liaisoning Officer for the purpose.

The initiatives under this MoA would facilitate the following:

- general academic cooperation,
- exchange of faculty for short periods of time, for delivering lectures and engaging in research,
- jointly work on major projects
- mutual participation of faculty in conferences and seminars
- curriculum development
- student exchange



MEMORANDUM OF AGREEMENT FOR ACADEMIC COOPERATION

BETWEEN

Daegu Catholic University, Republic of Korea

AND

Birla Institute of Technology, Mesra, India

This agreement is made and entered into on this 16th day of February 2024 between Daegu Catholic University (DCU) and Birla Institute of Technology, Mesra, Ranchi (hereinafter called BIT Mesra), situated at Mesra, Ranchi-835215, Jharkhand, a Deemed University under Section 3 of the UGC Act, 1956. Both Universities agree to establish a relationship of general academic cooperation. The purpose of this relationship is to enhance the capacity of both institutions to fulfil their educational missions and objectives through international education and engagement. The two institutions may undertake, subject to the regulatory framework and availability of resources, both initiatives in the following areas:

- Faculty exchanges for short periods of up to three months to deliver lectures, engage in research, and participate in ongoing joint projects in various subject areas
- Mutual participation of faculty in conferences, congresses, and symposia sponsored by each institution
- Sharing of research and published materials in disciplines and areas of interest to both institutions
- Joint projects in research and curriculum development
- Assistance with institutional and official networking in the country of each institution and inappropriate international frameworks and organizations
- Student exchanges for varying lengths of time
- General academic cooperation
- Dr. Pawan Kumar Tiwari, Faculty of Physics, would be a liaison officer in implementing the memorandum of agreement between the two universities.

The appendices to this document identify specific projects and activities that will be undertaken within this general agreement. Addenda may be developed at any time during the life of the agreement.

This MoA is not considered a contract creating legal or financial relationships between the parties. Instead, it is designed to facilitate developing and maintaining a mutually beneficial academic relationship.

This agreement will take effect immediately upon signing by both parties. Either party may terminate the agreement upon receipt of official written notification, which must be received by the other party three months in advance of the termination date. Any participating students who have commenced at either university during this period may complete their courses of study. Any modification in this agreement must be in writing and approved by both parties.

Dr. Han Gee Seong
President
Daegu Catholic University
Republic of Korea

Dr. Indranil Manna
Vice Chancellor
Birla Institute of Technology
Mesra, Ranchi, Jharkhand, India

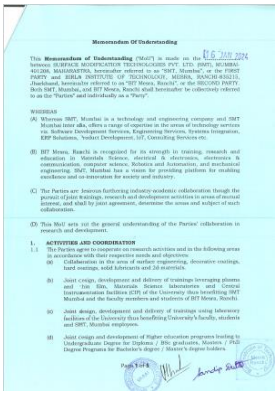
Witnesses:

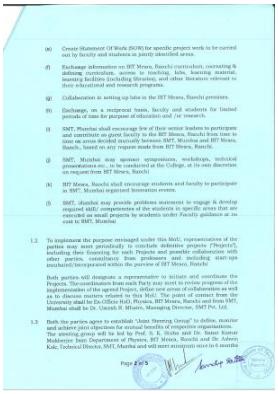
Dr. Jong In Youn
Vice-President, International Affairs,
DCU, Republic of Korea

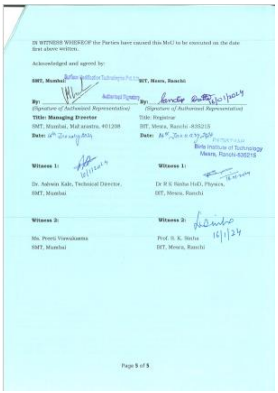
Dr. Ashoke Sharon
Dean, Faculty Affairs
BIT, Mesra, Ranchi, India

Memorandum of Understanding


Government of Jharkhand
Receipt of Online Payment of Stamp Duty


Memorandum Of Understanding





Industry – Academia collaboration

Birla Institute of Technology has signed a Memorandum of Understanding (MoU) with Surface Modification Technologies (SMT) Pvt Ltd., Mumbai, in consultation with the Department of Physics, for mutual cooperation in the area of surface enhancement solutions using Physical Vapour Deposition (PVD) and characterization of wear, adhesion, surface morphology, x-ray fluorescence, corrosion, etc.
This MoU will boost the career opportunities of our students and staff on either sides.

Publications

1. Utilizing blackbody radiation inversion to attain an upper bound on the mass of photon using cosmic microwave background radiation, P. Bhattacharjee, S. Dhal, R.K. Paul, *The European Physical Journal Plus* **139** (3), 1-11 (2024).

2. Surface-Plasmon-Polaritons for Reversible Assembly of Gold Nanoparticles, In Situ Nanogap Tuning, and SERS, C. Ghanashyam, R.K. Sinha, A. Bankapur, *Journal Small methods* **8** (1), 2301086 (2024).

3. Efficiency of a microscopic heat engine subjected to stochastic resetting, S. Lahiri, S. Gupta, *Physical Review E* **109**, 014129 (2024).

4. Stochastic heat engine using multiple interacting active particles, A. Kumari, Md. Samsuzzaman, A. Saha, S. Lahiri, *Physica A* **636**, 129575 (2024).

5. Investigation of structural, electrical and electrochemical properties of $La_{0.8}Sr_{0.2}Mn_{1-x}Sc_xO_{3-\delta}$ as cathode on yttria-stabilized zirconia electrolyte for intermediate temperature solid oxide fuel cell fabricated by one step dry pressing method, Gayatri Dash, Ela Rout, *Journal of Materials Science: Materials in Electronics* **35**, 491 (2024).

6. Defect scattering and thermionic landscape of acceptor doped BaCeO3 polymorph for intermediate temperature fuel cell technology, D. Vignesh, Ela Rout, *Ceramics International* **50** (10), 17323-17337 (2024).

7. Proton-Polaron and Thermionic Identity of BaCeO3 Polymorph for Intermediate Temperature Fuel Cell Technology: A First Principles and Molecular Dynamics Approach, D. Vignesh, Ela Rout, Ranjan Mittal, Mayank Kumar Gupta, *International Journal of Hydrogen Energy* **57**, 37-91 (2024).

8. Machine Learning Advent and Derivative Discontinuity of DFT Functionals Over Gap State Predictions Among $ACeO_3$ (A= Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}) Proton Conductors, D. Vignesh, Ela Rout, *Computational Materials Science* **231**, 112583 (2024).

9. Correlation between electronic polarization and shift current in cubic and hexagonal semiconductors LiZnX(X=P,As,Sb), U. Dey, J. van den Brink, Rajyavardhan Ray, *Physical Review Materials* **8**, 025001 (2024).

10. Ultra-fast switching memristors based on two-dimensional materials, S.S.T. Nibhanupudi*, Anupam Roy*, D. Veksler, M. Coupin, K.C. Matthews, M. Disiena, Ansh, J.V. Singh, J. Warner, J.P. Kulkarni, G. Bersuker, S.K. Banerjee, *Nature Communications* **15**, 2334 (2024).

11. Controlling the bandgap of graphene oxide via varying KMnO4, Manu Priyadarshani and Rishi Sharma, *Optical Materials* **147,** 114634 (2024).

12. A Systematic Investigation of the Structural Changes in Chemically and Thermally Reduced Graphene Oxide using Raman and XRD, Manu Priyadarshani, Kumari Neha, Rupali Rani, and Rishi Sharma, *Surface Review and Letters* (2024). doi: https://doi.org/10.1142/S0218625X24501051

13. A DFT insight into the physical features of alkaline based perovskite compounds AInBr3 (A= K, Rb), Debidatta Behera, Dhan Raj Lawati, M Agouri, A Abbassi, S Taj, B Manaut, Sanat Kumar Mukherjee, *Solid State Ionics* **409,** 116513 (2024).

14. Insights into spray-coated p-type Li-doped ZnO thin films: An examination of structural, chemical, optical, and electrical characteristics, Mohamedi Mohamed Walid, Rajan Singh, Nebatti Ech-Chergui Abdelkader, Sanat Kumar Mukherjee, et. al., *MRS Advances* (2014).
doi: https://doi.org/10.1557/s43580-024-00805-4

Publications

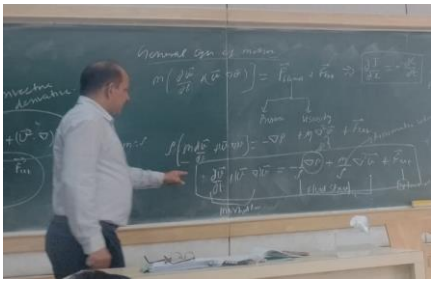
15. Enhanced photocatalytic efficiency of sol-gel derived ZnS-rGO binary nanocomposite, Priyanka Kumari, Aashish Sharma, Saurav Mishra, Praveen Kumar Surolia, Sanat Kumar Mukherjee, Kamakhya Prakash Misra, Susruta Samanta, Sanjib Kabi and Saikat Chattopadhayay, *Physica Scripta* **99**, 055918 (2024).
16. First-principle analysis of optical and thermoelectric properties in alkaline-based perovskite compounds AInCl3 (A = K, Rb), Debidatta Behera, Tesfaye Abebe Geleta, I Allaoui, Mohamed Khuili, Sanat Kumar Mukherjee, Boumaza Akila, Samah Al-Qaisi, *The European Physical Journal Plus* **139** (2), 127 (2024).
17. First principle studies on structural, elastic, electronic, optical, and thermoelectric properties of new pero vskite TlTaO3: For renewable energy applications, Sangeeta Lakra, S. K. Mukherjee, *Journal of Computational Chemistry* **45** (13), 1008 (2024).
18. First principle studies on structural, electronic, elastic, optical, and thermoelectric properties of XGeCl3 (X= Rb/Cs): Promising compounds for green energy application, Debidatta Behera, M Boudjelal, M Batouche, T Seddik, Dj Hemidi, Sanat Kumar Mukherjee, *International Journal of Quantum Chemistry* **124** (1), e27342 (2024).
19. Investigation on the electrocatalytic oxidation of alcohol using zinc oxide thin films deposited by pulsed electrodeposition on an indium tin oxide surface, Meriem Lakhdari, Khadidja Hadj Larbi, Abdelkader Nebatti Ech-chergui, Farid Habelhames, Nourddine Benaioun, Jean Michel Nunzi, Sanat Kumar Mukherjee, Mehdi Adjdir, *Revista Mexicana de Física* **70**, 011005 (2024).
20. Diffusion in a complex mixture with random pairwise interparticle interactions, S Das, S Suvarna and M Priya, *AIP Conference Proceedings* **2995** (1), (2024).
21. Role of range of interaction potential on structure and dynamics of a one-component system of particles interacting via Mie potential, S Suvarna and M Priya, *AIP Advances* **14**, 045030 (2024).

Book Chapter

Book Chapter: Review of the Role of Aerosols in the Spread of COVID-19, N. Srivastava, Book Title: Aerosol Optical Depth and Precipitation. Gautam, S., Kumar, R.P., Samuel, C. (eds), Springer, Cham. (2024), Online ISBN: 978-3-031-55836-8. https://doi.org/10.1007/978-3-031-55836-8_10.

New Courses @ Physics Department

A course on Biophysics (PH328) and Biophysics Laboratory (PH329) classes has been introduced for the first time in the Department of Physics, BIT Mesra starting spring semester of 2024. The objective of floating this course is to equalize the standard of course curriculum at an international level where the top-ranking universities have given utmost importance to interdisciplinary teaching and research.



The fundamental knowledge might instigate students to pursue an advanced course on related subjects such as bioinformatics, biomechanics, bioelectromagnetics, etc. Students might find a probable employment opportunity in the multiphysics simulation tool development conglomerates such as COMSOL, ANSYS, ABAQUS, etc. Considering the broad scope of Biophysics, the department may design an advanced course on Biophysics.

ChalkTalks

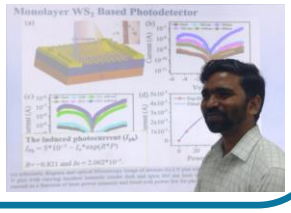
https://sites.google.com/view/ct-phys-bitmesra/home

In the *ChalkTalk* lecture series a talk on Higgs particle --- aka the God particle --- at the Large Hadron Collider (LHC) was delivered by Dr. Ramkrishna Dewanjee.

The discovery of the Higgs boson was one of the most important milestone in particle physics. Not only did it establish the mass generation mechanism within the standard model of particle physics, but also gave physics its first fundamental scalar particle. In this 3-part seminar series, the speaker discussed several aspects of his journey to the discovery of the God particle and related subtleties. In the 1st part of the talk, the focus was on the experimental aspects, especially the workings of the detectors, etc at LHC. In the 2nd part of the talk, the focus was on a brief discussion of the Higgs boson physics. In the concluding part of the series, the data-driven learning and analysis of the experimental data was discussed. Just to provide a scale of data handled by CERN experiments, approximately 1 PB (petabytes) of data is handled per year, making the CERN team a clear expert in advanced learning algorithms, deep neural networks, etc. The speaker also briefly touched upon what this discovery implies for possible new physics beyond the standard model.

PhD awarded

Ms. Aradhana Kumari, Ph.D. student of **Dr. Sourabh Lahiri**, successfully defended her thesis entitled "Study of Some Useful Extensions of Stochastic Heat Engines and Refrigerators" on January 19, 2024, and has been recommended for the degree of Ph.D. in science.



Mr. Rakesh Kr Prasad successfully defended his Ph.D titled "Growth and Characterization of Monolayered Semiconductors for Photodetector Applications" under supervision of **Dr. Dilip Kumar Singh**.

Awards & Recognition

Mr. Apurba Tewari, Research Scholar under **Dr Nishi Srivastava**, received the prestigious CSIR Direct SRF

Neha Chakraborty, Research Scholar, UGC-SJSGC SRF, Department of Physics working under the guidance of **Dr. Rishi Sharma**.

1. has been awarded SRF under UGC-SJSGC.
2. has received the Best Poster Presentation Award at the 1st International Conference on Advances in Novel Materials: Towards a Sustainable Future (ICAN 24) at St. Xavier's College, Ranchi.
3. has received the Best Oral Presentation Award at the 3rd DAE-BRNS Symposium on Current Trends in Analytical Chemistry (CTAC–2023) at BARC, Mumbai.

Mr. Vignesh under the guidance of **Dr. Ela Rout**, was awarded the Best Poster Presentation at the 2nd International Conference on Energy Materials and Devices (ICEMD-2024) during 19th to 21st March, 2024, organized at the MMV, Banaras Hindu University, Varanasi.

Ms. Somita Dhal working under the supervision of **Dr Ratan Kumar Paul**, has been awarded SRF, UGC -SJSGC (Savitribai Jyotirao Phule Single Girl Child) Fellowship since April, 2024

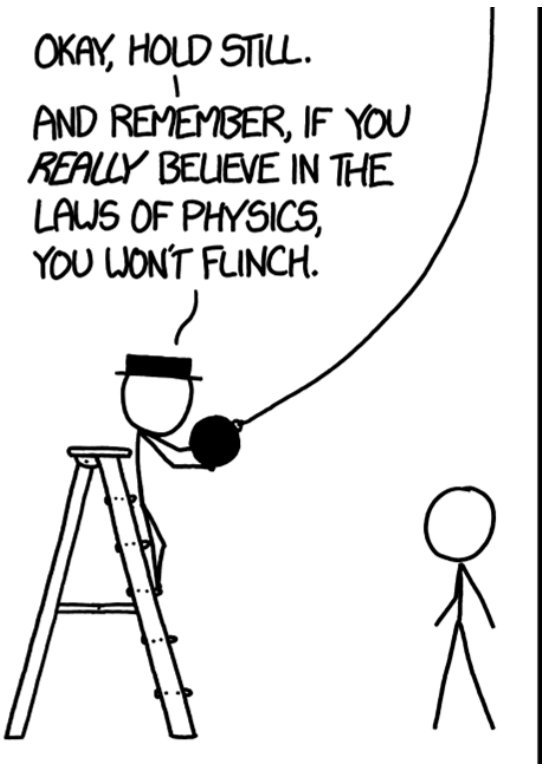
Mr. Sarurav Dubey under the guidance of **Dr. Dilip K. Singh,** bagged 1st prize for Poster presentation during National Science Day held on 28th February, 2024 and at Coalescence'24 organized by Indian Institute of Chemical Engineers (IIChE) held on 2nd March. 2024.

Physics Dept. is actively pursuing inter-departmental research. **Mr. Somrup Naga** a UG student of the Department of Production Engineering working under the guidance of **Dr. P K Tiwari**, presented a paper titled "Mediating Machine Learning Techniques between Plasma Technology and Electric Field in Water Desalination and Purification", at International Conference on Data Analytics and Management, at the XISS Ranchi, held during 15 & 16 March 2024, received Best Paper Award.

Students' section

Educational tour to NML Jamshedpur

A group comprising of MSc and Integrated MSc students, led by Dr. P K Tiwari and Dr. Madhu Priya, went on an educational trip to the CSIR - National Metallurgical Laboratory (NML) at Jamshedpur, on the 4th of January 2024. wherein they got an opportunity to explore the fascinating realm of rapid solidification, a cutting-edge field at the intersection of materials science and engineering. material strength, e-waste recycling etc. The primary research perused by this division is developing an understanding of the material and alloy's properties, in both room and high-temperatures. Iron-, aluminum- and nickel-based alloys are the most studied by this research division. Visiting students could see the state-of-the-art research facilities for microstructure and structure characterization, creep, fatigue and high strain rate deformation properties studies.



Why science teachers should not be given playground duty.

Students' section

We bid Farewell !
to the passing out batch
MSc 2022-24 & IMSc 2019-2024

Editorial team

M. K. Sinha, mksinha@bitmesra.ac.in
Dr. Anupam Roy, royanupam@bitmesra.ac.in
Dr. Sourabh Lahiri, sourabhlahiri@bitmesra.ac.in
Dr. Rajyavardhan Ray, r.ray@bitmesra.ac.in