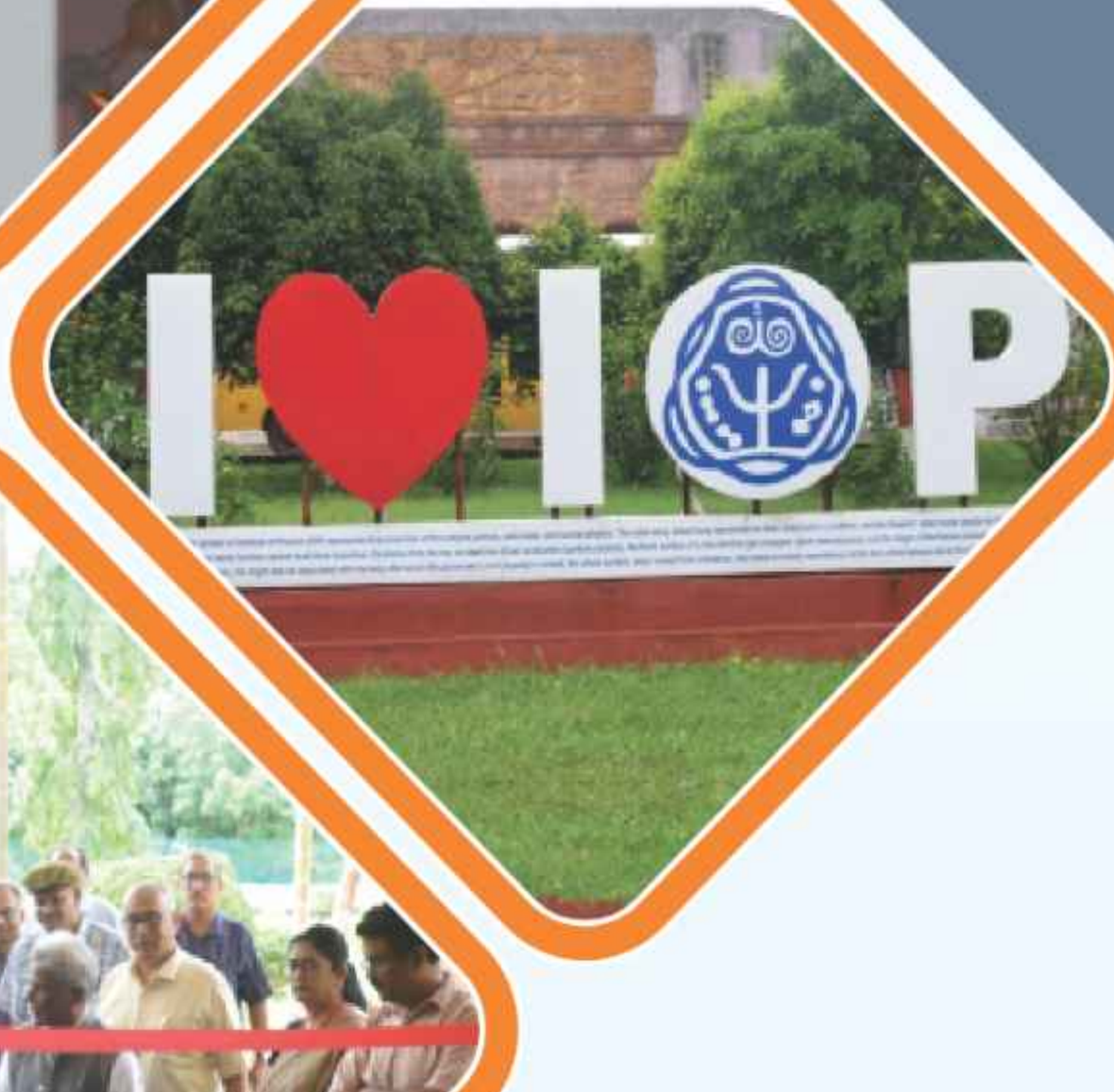
ANNUAL Report 2023-24



AUDITED STATEMENT OF ACCOUNTS

Institute of Physics
BHUBANESWAR

Annual Report

&

AUDITED STATEMENT OF ACCOUNTS

2023-24

Institute of Physics

BHUBANESWAR

INSTITUTE OF PHYSICS

Sachivalaya Marg, P.O.: Sainik School
Bhubaneswar - 751 005
Odisha, India

Phone: +91-674- 2306 400/444/555
Fax: +91-674- 2300142
URL: http://www.iopb.res.in

Editors

Prof. Debasish Chaudhuri
Prof. Kirtiman Ghosh
Prof. Debottam Das
Dr. Basudev Mohanty

Published by

Lt. Col. Bibekananda Pattanaik, Registrar

Compiled by

Shri Rajesh Mohapatra

Hindi Transalation by

Shri Bhagaban Behera

Contents

राष्ट्र की सेवा में परमाणु
भौ सं
IOP
ATOMS IN THE SERVICE OF THE NATION

About the Institute

Institute of Physics, Bhubaneswar is an autonomous research institution within the Department of Atomic Energy (DAE), Government of India. The Institute was established in 1972 by the Government of Odisha and continues to receive financial assistance from DAE and Govt. of Odisha.

The Institute has a vibrant research programme in the fields of theoretical and experimental condensed matter physics, theoretical high energy physics and string theory, theoretical nuclear physics, ultra-relativistic heavy-ion collisions and cosmology, quantum information and experimental high energy nuclear physics. The accelerator facilities include a 3MV Pelletron accelerator and a low-energy implanter. These are being used for studies in low energy nuclear physics, ion beam interactions, surface modification and analysis, trace elemental analysis, materials characterization, and radiocarbon dating studies. One of the important areas in the Institute is in the field of Nanoscience and Nanotechnology in general and surface and interface studies in particular. The Institute has several advanced facilities for sample preparation and for the study of various physical and chemical properties of nanostructures and bulk condensed matter systems. The Institute is actively involved in the International Collaborations with CERN (Switzerland), BNL (USA), ANL (USA), GSI (Germany), and other laboratories abroad. The Institute is also participating in various research activities related to India-based Neutrino observatory.

The Institute offers Ph.D. programme in Physics. Selected students are required to successfully complete one-year course work at the Institute. The selection for the doctoral programme is through the Joint Entrance Screening Test (JEST). Candidates who have high CSIR-UGC NET or GATE scores are also eligible for admission to the doctoral program.

The Institute campus has housing facilities for the employees and hostels for the scholars and post-doctoral fellows. Compact efficiency apartments are available for post-doctoral fellows and visitors. Both indoor and outdoor games and sports facilities are also available in the campus. The Institute has a mini-gym in the New Hostel. The Institute also has a guest house, auditorium, and dispensary in the campus. The Foundation Day of the Institute is celebrated on 4th of September every year.

राष्ट्र की सेवा में परमाणु
भौ सं
IOP
ATOMS IN THE SERVICE OF THE NATION

CHAIRMAN AND MEMBERS OF THE GOVERNING COUNCIL OF IOP, BHUBANESWAR

Prof. Ajit Kumar Mohanty, Chairman (AEC) and Secretary (DAE), Department of Atomic Energy, Anushakti Bhavan, C.S.M. Marg, Mumbai-400001	:	Chairman
Prof. Karuna Kar Nanda, Director, Institute of Physics Bhubaneswar-751005	:	Member
Prof. Pinaki Majumdar, Director Harish-Chandra Research Institute, Chhatnag Road, Jhunsi, Allahabad-211019 (up to 31.01.2024).	:	Member
Prof. Dileep Jatkar, Acting Director, Harish-Chandra Research Institute, Chhatnag Road, Jhunsi, Allahabad-211019 (from 01.02.2024).	:	Member
Prof. Gautam Bhattacharyya, Director, Saha Institute of Nuclear Physics Sector-1, Block-A/F, Bidhan Nagar, Kolkata-700064.	:	Member
Prof. Sudhakar Panda, Director, National Institute of Science Education and Research, Post. Jatni Dist. Khordha-752050 (up to 30.04.2023).	:	Member
Prof. A. Srinivasan, Officiating Director, National Institute of Science Education and Research, Post. Jatni, Dist. Khordha-752050 (from 01.05.2023 to 28.09.2023).	:	Member
Prof. Hirendra Nath Ghosh. Director, National Institute of Science Education and Research, Post Jatni Dist. Khordha-752050 (from 29.09.2023).	:	Member
Dr. Shashank Chaturvedi, Director, Institute of Plasma Research, Bhat Village, Near Indira Bridge, Gandhinagar-382428.	:	Member
Smt Sushma Taishete, Joint Secretary (R&D), Deptt. of Atomic Energy Anushakti Bhavan, C.S.M. Marg, Mumbai-400001.	:	Member
Smt. Richa Bagla, IAS, Joint Secretary (Finance), Department of Atomic Energy, Anushakti Bhavan, C.S.M. Marg, Mumbai-400001.	:	Member
Shri Bhaskar Jyoti Sharma, IAS, Commissioner-cum Secretary, Science & Technology Deptt., Government of Odisha, Bhubaneswar-751001 (up to 22.05.2023).	:	Member
Smt. Chithra Arumugam, IAS, Principal Secretary, Science & Technology Department, Government of Odisha, Bhubaneswar-751001 (from 23.05.2023).	:	Member
Prof. Manas Ranjan Panigrahi, Department of Physics, Veer Surendra Sai University of Technology (VSSUT), Burla.	:	Member
Prof. Susmita Kar, Professor and Head, P.G.Department of Physics, Sriram Chandra Bhanjadeo University, Baripada.	:	Member

SECRETARY TO THE GOVERNING COUNCIL, BHUBANESWAR

Prof. P. K. Sahu, Acting Registrar, Institute of Physics (up to 31.07.2023)
Dr. S. N. Sarangi, Acting Registrar, Institute of Physics (from 01.08.2023)

राष्ट्र की सेवा में परमाणु
भौ सं
IOP
ATOMS IN THE SERVICE OF THE NATION

From the Director's Desk . . .

I am delighted to present the "Annual Report andAudited Statement of Accounts" of the Institute of Physics (IoP), Bhubaneswar for the year 2023-24. This report provides a summary of our academic and research activities and our accomplishments. IoP, Bhubaneswar is an autonomous research Institute under the umbrella of the Department of Atomic Energy (DAE), Government of India. It is one of the leading research Institutes in India and its mission is to conduct high-quality cutting-edge scientific research in both experimental and theoretical physics.

This year, an impressive number (173) of research papers in high-quality international peer-reviewed journals have been published by IoP faculty members. Apart from the peer-reviewed articles, IoP members have also contributed to book chapters, popular articles, and conference proceedings. Importantly, faculty members of the Institute are associated with different reputed international scientific organizations. IoP is also actively involved in international mega project collaborations such as ALICE and CMS.

Members of the Institute have received many accolades. They have also been awarded by various international institutions/universities. Prof. K. K. Nanda, Director has been bestowed with Prof. N. N. Dasgupta Memorial Award, 2023 by the Indian Photobiology Society, Jadavpur University, Kolkata for his pioneering contributions in the area of Nanoscience and Nanotechnology, especially in the applications in sensing and catalysis. He has been honored with an Adjunct Professorship from Gangadhar Meher University, Sambalpur, and also honored with Fellow of the International Association of Advanced Materials, Sweden. Prof. Shikha Varma has been associated with DST-SERB, and IUAC as a committee member. Dr. S. K. Agarwala has been awarded the Rajib Goyal Prize by the Kurukshetra University. Prof. T. Som is associated with members of DST, IIEST and IBSI, etc. Prof. A. K. Nayak was appointed as Trigger Officer of CMS collaboration. Prof. D. Chaudhuri has been honored with a visiting

Professorship of CYCergy Paris University, France, ICTS-TIFR and Max-Planck Insitute for the Physics of Complex Systems (MPIPKS), Germany.

Research scholars of IoP have also received awards for best oral and poster presentations at National and International conferences. Mr. Sameer Kumar Mallik was awarded the bestoral presentation at the ICLED-2023 held at NUSin Singapore for his research work under the supervision of Prof. Satyaprakash Sahoo. Ms. Sandhyarani Sahoo received the best poster award at the International Conference on Thin Film and Nanotechnology (ITCN-KCL2023) which was held at IIT Madras, Chennai, for her research work under the guidance of Prof. Satyaprakash Sahoo. Mr. Sanu Varghese received the CMS Award-2022 during CMS Week June 2023 for his outstanding contributions to high-level trigger rate studies in the CMS Experiment.

During 2023-24, the Institute observed the 49th Foundation Day on 4th September 2023 in which Prof. Pinaki Majumdar, Director HRI, Prayagraj graced the occasion as Chief Guest. IoP has been actively involved in promoting scientific education and outreach. The Institute has observed Azadi Ka Amrit Mahotsav (AKAM) and Swachh Bharat scientific outreach programs for communicating science and scientific temper to school and college students, teachers, and the public. The team members from IoP visited different tribal districts of Odisha to organize such activities.

The Institute regularly organizes the visits of students from different colleges and universities. These activities aim to inspire young students about fundamental and applied scientific research. Activities like night sky viewing with telescopes, Popular Science talks, and societal issues are also being conducted. National and international conferences have been organized and NationalScience Day has been observed as "OPEN DAY" by demonstrating live experiments to motivate young minds for Science.

In addition, emphasis has been given to the implementation of the policy of the Government. Official Language Implementation in the Institute, Celebration of International Women's Day, International Yoga Day, Observance of Vigilance Awareness Week, DAE Iconic Week, etc. are some of them.

At last, I take this opportunity to acknowledge my sincere gratitude to all the stakeholders of the IoP community including the Governing Council members for their continuous support and advice. I would also like to thank all the faculty and staff for their relentless effort to take the institute to a greater height. My special thanks to the committee members for preparing this Annual Report. I am confident that the Institute will continue to make significant contributions to both fundamental and applied physics research in the years to come.

Professor Karuna Kar Nanda
Director, IoP

Chapter 1

ACADEMIC PROGRAMMES

1.1 PRE-DOCTORAL PROGRAM

One of the most important objectives of the Institute is to train and guide young scholars to do research in physics. Since 1975, IOP has a regular Pre-doctoral (Post M.Sc.) course, which is a very important academic program because it is designed to train the M.Sc. students for carrying out research activities. This programme is aimed at imparting a broad based training in advanced physics and research methodology to students. The course work is planned with the view that it should help the students not only in doctoral research, but also enable him/her to become a good physics teacher. The Institute participates in conducting the Joint Entrance Screening Test (JEST) to select students who are interested in pursuing Ph.D. in physics. The final selection of a student is based on the result of written test and an interview conducted at the institute. This year the Pre-doctoral course began in August 2023. On completion of the Pre-doctoral program, students are eligible to join research under the supervision of faculty members of the Institute, leading to the Ph.D. degree awarded by HomiBhabha National Institute (HBNI).

Pre-doctoral Scholars selected for the AY 2023-24

A total of 56 students were called for written test and interview for admission to the pre doctoral course in August, 2023. This includes JEST qualifiers, UGC-CSIR qualifiers and valid GATE score holders. Following students enrolled to the doctoral course work program for the year 2023-2024:

1. Mr. Babulu Pradhan
2. Mr. Subhankar Gope
3. Mr. Nutan Das
4. Mr. Abhishek Hota
5. Mr. Jayantakumar Panigrahi
6. Mr. Debidatta Mohanty
7. Mr. Ohidul Alam
8. Mr. Dhananjay Moharana
9. Mr. Shanu Bandyopadhyay

Details of the courses offered and course instructors are given below

Semester – I

Advanced Quantum Mechanics	: Prof. Sudipta Mukherji
Quantum Field Theory – I	: Dr. Manimala Mitra
Advanced Experimental Techniques	: Prof. Tapobrata Som
Experimental Physics Lab	: Prof. Satyaprakash Sahoo
Many Body Physics	: Prof. Saptarshi Mandal
Advanced Statistical Mechanics	: Prof. Debasish Chaudhuri

Semester – II

Mathematical Methods	:	Prof. Goutam Tripathy/ Prof. P. K. Sahu
Quantum Field Theory – II	:	Dr. Debottam Das
High Energy Physics	:	Dr. Kirtiman Ghosh
Special Topics in Condensed Matter Physics	:	Prof. Debakanta Samal / Prof. B. R. Sekhar
Advanced Condensed Matter Physics	:	Prof. Arijit Saha

As a part of the course work, students also worked on projects in the last Semester under supervision of faculty members of the institute.

Scholars successfully completed Pre-Doctoral Course for AY 2022-23:

1. Mr. Smruti Ranjan Senapaty
2. Ms. Ruma Khatun
3. Ms. Minakshi Subhadarshini
4. Mr. Raj Rajiv Upadhyay
5. Mr. Tarakeshwar Mondal
6. Mr. Subham Saha
7. Mr. Sambhav Antariksha
8. Mr. Debabrata Sahoo
9. Ms. Ankita Ghosh

The Institute has instituted Lalit Kumar Panda Memorial Endowment Fellowship (*L. K. Panda Memorial Fellowship)* to recognize the talent for the most outstanding pre-doctoral student and Mr. Subham Saha was awarded the fellowship consisting of a cash prize of Rs.5,000/- for Academic Year 2022-23.

1.2 DOCTORAL PROGRAM

Presently Institute has thirty five doctoral scholars working in different areas under the supervision of its faculty members. All the scholars are registered with Homi Bhabha National Institute (HBNI), a deemed-to-be University within DAE. Progress of each doctoral scholar is reviewed annually by a review committee. This year reviews were held in the months of July-August.

1.3 POST-DOCTORAL FELLOWS

1. Dr. Koushik Naskar
2. Dr. Hemanta Kumar Sharma
3. Dr. Joy Mukherjee
4. Dr. Rasmita Sahoo
5. Dr. Abhijit Kumar Saha

POST-DOCTORAL FELLOWS (P)-ALICE

1. Dr. Bhanu Sharma

POST-DOCTORAL FELLOWS (P)-CEFIPRA

1. Dr. Md. Ishquae Khan

POST-DOCTORAL FELLOWS (P)-APEX

1. Dr. Pavan Kumar Yerra
2. Dr. Rajneesh Kumar
3. Dr. Songshaptak De
4. Dr. Lalit Kumar Saini
5. Dr. Ashish
6. Dr. Ramita Sarkar
7. Dr. Jit Satra
8. Dr. Smrutirekha Swain
9. Dr. Arvind Bhaskar
10. Dr. Subhadeep Datta
11. Dr. Abhishek Das
12. Dr. Sukanta Kumar Jena
13. Dr. Harisamkar S
14. Dr. Mrinal Kanti Sikdar
15. Dr. Arindam Lala
16. Dr. Purusottam Ghosh
17. Dr. Pooja Saini
18. Dr. Sudipta Moshat

1.4 THESES (Defended) / Submitted

The following scholars have been awarded Ph.D. degree by Homi Bhabha National Institute on the basis of thesis defended.

1. **Mr. Biswajit Das**
   Advisor: Prof. Pankaj Agrawal
   Thesis Title: "Probing Anomalous Higgs Boson Couplings at Colliders"

2. **Ms. Dilruba Hasina**
   Advisor: Prof. Tapobrata Som
   Thesis Title*:* "Nanoscale TiO_x - based memristive synaptic devices for neuromorphic computing applications: role of defect engineering"

3. **Mr. Alapan Dutta**
   Advisor: Prof. Tapobrata Som
   Thesis Title*:* "Optoelectronic optimization of thin films related to the metal Oxide contact-based photovoltaic cell"

4. **Mr. Subhadip Jana**
   Advisor: Prof. Debakanta Samal
   Thesis Title*:*"Spin-orbit coupled electron transport, interface magnetism in transition metal oxide and heavy metal thin films"

5. **Mr. Avnish**
   Advisor: Prof. Kirtiman Ghosh
   Thesis Title*:*"Exploring Neutrino Mass and Dark Matter Motivated TeV scale scenarios at the Collider Experiments"

6. **Ms. Rojalin Pradhan**
Advisor: Prof. Manimala Mitra
Thesis Title: "Phenomenology of neutrino mass models at present and future collider experiments"

7. **Mr. Arnob Kumar Ghosh**
Advisor: Prof. Arijit Saha
Thesis Title:"Floquet generation of higher-order topological systems"

8. **Mr. Vinay Krishnan M.B**
Advisor: Prof. Aruna Ku. Nayak
Thesis Title: "Study on CP-nature of the Higgs interaction with Ä lepton at CMS experiment and invariant mass reconstruction of heavy gauge bosons using machine learning techniques"

9. **Mr. Bibhabasu De**
Advisor: Prof. Aruna Ku. Nayak
Thesis Title: "Exploring signatures of supersymmetric and non-supersymmetric models through colliders, cosmological and precision data of observables."

10. **Mr. Ankit Kumar**
Advisor: Prof. S. K. Patra
Thesis Title:"Structural Properties and Thermal Evolution of Neutron Stars through Dense Matter Equation of State with Gravitational Observational Constraints."

1.5 Summer Student's Visiting Program (SSVP):

Name of the Student	Advisor
Himanka Roy	Dr. Debottam Das
Swarna Laxmi Behera	Prof. Sudipta Mukherji
Deepika Jena	Prof. P. K. Sahu
Papul Sahu	Dr. Aparajita Mandal
Debnath Samanta	Dr. Aparajita Mandal
Satyam Agrawal	Prof. T. Som
Surya Vamsi Allada	Prof. S. K. Patra

The motivation of the SSVP program is to expose young students to frontline research areas, especially in the areas of research work pursuing at the Institute. This year the SSVP was held from 8thMay to 17th June, 2023.Seven students participated in the program. Round trip train fare, accommodation on campus, and a monthly stipend of Rs. 6000/- was provided to all the visiting students. Under this program, each student worked under the guidance of a faculty member of the Institute. At the end of the program, students presented their work in a seminar on the assigned topics

1.6 Conferences/ Workshops organized by IOP

1.6.1 International workshop on Physics of life: Active and living matter (PoL24)

The workshop on "Physics of life: Active and living matter (PoL24)" is a part of the Golden Jubilee celebration of the Institute of Physics, Bhubaneswar. The conference is co-organized by the Indian Institute of Science Education and Research, Mohali (IISER Mohali).

Research in active systems, both natural and artificial, is developing quickly. In order to comprehend and address biological issues, fundamental physics principles have been used, and artificial active systems have opened up new possibilities for emergent phenomena. New experimental findings question the early theories, and novel theoretical ideas illuminate various collective processes. This workshop provided an environment where theorists and experimentalists could interact and share their viewpoints on active systems. We concentrated on exchanging ideas involving novel experiments, models, and emergent collective properties. With this workshop, we brought together a diverse and active group of scientists to exchange ideas. The topics included:

- Natural and artificial active systems across all scales
- Biophysics of cells to tissues, morphogenesis
- Active scalar, vector, and tensorial matter
- Collective properties: alignment, phase separation, and beyond
- Active colloids, polymers, and membranes
- Chiral active systems
- Physics of self-propelled components
- Active visco-elastic systems

The workshop was attended by 61 participants including 31 invited speakers. Several distinguished scientists participated in the workshop, including Professors Madan Rao, Fernando Peruani, P B Sunil Kumar, Shashi Thutupalli, Vijaykumar Krishnamurthy, Sanjib Sabhapandit, Sumesh P Thampi, Raghunath Chelakkot, Saroj Nandi, Shradha Mishra, Prasad Parlekar, Pramod A Pullarkat, Kabir Ramola, Anirban Sain, Sathish Akella, Abhik Basu, Urna Basu, Pinaki Chaudhuri, Vijaykumar Chikkadi, Subir K Das, P K Mohanty, Sudipto Muhuri, Amitabha Nandi, Arnab Pal, Raja Paul, Subhajit Paul, Punyabrata Pradhan, Sabyasachi Rakshit, Arnab Saha, R Srinivasan, and Snigdha Thakur.

1.6.2 National Conference on Electronic Structure 2023 (NCES-2023) during 15-17 November 2023 at Gopalpur, Odisha

The main objective of this focused conference is to provide a unique platform for the discussions and interactions on the recent advances in electron spectroscopy, microscopy, and related theoretical approaches in understanding the electronic structure of materials. NCES is also aimed at the capacity building in the field of electronic structure. Scientists from Universities and Research Institutes working in spectroscopy, microscopy and related theory are invited to discuss their results and brainstorm future developments. The conference's topics include, ARPES, XPS, STS, EXAFS, XANES, DFT, Strongly Correlated Systems, Superconductivity, Topological Materials, Quantum Solids.

This was a special event for the Golden Jubilee year of IOP Bhubaneswar in collaboration with TIFR Mumbai, SINP Kolkata and SNBNCBS Kolkata.

1.7 Awards & Recognitions by Faculty Members

Prof. K. K. Nanda

1. Featured in 2% of Scientist in Nanoscience & Nanotechnology (Applied Physics) category published by Stanford University in 2020-2023.
2. Featured in 0.05% of Science in All Fields published by ScholarGPS™, Meta Analytics LLC in 2024 (an American company based in California)
3. Ranked 145 in the field of Materials Science in India and 9344 worldwide published Research.com team in 2024.
4. Professor N N Dasgupta Memorial Award 2023 Indian Photobiology Society.

Prof. Shikha Verma, Ex – Professor

1. Part of National/ international Committees/Boards: DST, ANRF, SERB
2. Core Member SERB- Program Advisory Committee (PAC) on Physics-I (Condensed Matter Physics & Material Science) (Since 2021)
3. Core Member - SERB Expert Committee on Start-up Research Grant (SRG) and National Postdoctoral (NPDF) Fellowship Schemes (since 2021)
4. Member of Review Committee SERB POWER- grant (since 2021)
5. Member of Search cum Selection Committee SERB POWER Fellow (since 2022)
6. Member of Expert Committee SERB Women Excellence Award WEA (since 2022)
7. Member Expert Committee DST Inspire Fellowship Physical Sci. level-II (since 2022)

8. Inter University Accelerator Center (IUAC)

i. Chairperson Accelerator User Committee (AUC), IUAC, N. Delhi (since 2021)

ii. Member Governing Council, IUAC, N. Delhi (since 2021)

iii. Member Governing Board, IUAC, N. Delhi (since 2021)

iv. Member Finance Committee, IUAC, N. Delhi (since 2021)

9. Editorial Boards

i. Editorial board member of Journal PRAMANA (since 2022)

ii. Review Editorial Board member of International Journal 'Frontier' (since 2015)

10. Other committees

i. Chairperson: Gender in Physics-Working Group (GIPWG-CMP) of IPA (since 2022)

ii. Member Selection-committee for Indian Physics Association (IPA) awards (Murali M. Chugani Memorial Award & N.S. Satya Murthy Memorial Award)(since 2022)

iii. Executive Committee Member (Joint Secretary-East) Ion Beam Society of In-dia (2015-2023)

Prof. Tapobrata Som

1. Member, Review Committee of DST, Govt. of India for Solar Energy Hub established at Indian Institute of Engineering Science and Technology (IIEST), Shibpur (Continu-ing)

2. Vice-President (Eastern India), Ion Beam Society of India (Nov. 2023 ¬ till date)

Prof. Aruna Kumar Nayak

1. Appointed as Trigger Officer (L2 convener position) Physics coordination of CMS collaboration for Sep. 2024 – Aug. 2026.

2. Received CERN Corresponding Associateship for 1st May. – 31st August, 2023.

3. Sanu Varghese (student of Dr. A. K. Nayak), Received CMS Award 2022, during CMS week June-2023, for his outstanding contributions to High level trigger rate studies in CMS experiment.

Prof. Debasish Chaudhuri

1. Receive a Visiting Professorship from CY Cergy Paris University, Paris, France, and visited them from 14 May to 27 May 2023.

2. Awarded an Associateship of the International Centre for Theoretical Sciences (ICTS-TIFR) for three years from January 2023 to December 2025.

Perspectives in Active Systems" (Active23) held at the Max-Planck Institute for the Physics of Complex Systems (MPIPKS), Dresden, Germany (24-28 April 2023).

4. The Max-Planck Institute for the Physics of Complex Systems (MPIPKS) in Dres-den, Germany, graciously hosted as a Visiting Scientist from 1 April to 13 May 2023.

Prof. Sanjib K Agarwalla

1. Rajib Goyal Prize for the year 2021-22 in Physical Sciences.
2. Felicitated by the Goyal Prizes Committee, Kurukshetra University One Medal, Citation, Rs.1.00 Lakh.

1.8 Awards and Recognitions by Scholars

1. Sameer Kumar Mallik, Scholar of Prof. Satyaprakash Sahoo was awarded the best oral presentation at the International Conference on Low-Energy Digital Devices and Computing (ICLED-2023), which was held on June 29-July 01, 2023, at NUS in Singapore.
2. Ms. Sandhyarani Sahoo, a scholar of Prof. Satyaprakash Sahoo won the best poster award at the International Conference on Thin Film and Nanotechno- logy (ITCN-KCL 2023), which was held from July 06-08, 2023 at IIT Madras, Chennai.

1.9 Talks Delivered

Prof. J. Maharana, Ex- Professor of the Institute

1. **Analyticity of Scattering Amplitudes for Compactified Field Theories**. Institute of Theoretical Physics, University of Amsterdam, Netherlands, October, 2023.
2. **Compactification of 5-dimensional field theory and analyticity of scattering amplitude** INFN Milan, Italy, October 2023.
3. **Proof of nonforward dispersion relation for Compactified field theory on a Circle** University of Michigan, Ann Arbor, Michigan USA, October 2023.
4. **Proof of Disperrtsion relation for scattering amplitude of a scalar field theory with Compact dimension**. Princeton University, November, 2023.

Prof. S. K. Patra

1. Inter-National Conference, NIT Rourkela,
2. National Conference, Thapar University, Patiala.
3. Collabprative talk given at IISER, Berhampur. DAE Symposium at IIT Indore, Chintan Shivir, ICTS Banguluru.

4. At SCAAA meeting & IPN meeting

Prof. B. R. Sekhar

1. Talk Delivered at NCES-2023 topics included, ARPES, XPS, STS, EXAFS, XANES, DFT, Strongly Correlated Systems, Superconductivity, Topological Materials, Quantum Solids.

Prof. Tapobrata Som

1. 11th International Conference on Materials for Advanced Technologies (ICMAT-2023), Suntec Convention Centre, Singapore [June 26-30, 2023] (Talk on June 27, 2023]
2. 1st International Conference on Low Energy Devices (ICLED-2023), National University of Singapore [June 29 - July 1, 2023] (Talk on June 28, 2023]
3. International Conference on Advanced Materials for Better Tomorrow II (AMBT 2023), Banaras Hindu University [October 10 - 13, 2023] (Talk on October 11, 2023)
4. 7th International Conference on Nanostructuring by Ion Beams (ICNIB 2023), University of Petroleum and Energy Studies, Dehradun [November 2-4, 2023] (Talk on November 3, 2023)
5. 34th AGM MRSI and 5th Indian Materials Conclave, IIT (BHU) Varanasi [December 12-15, 2023] (Talk on December 14, 2023)
6. ATAL Academy Faculty Development Program on Emerging Synaptic Devices for Neuro-morphic-computing: Towards Industry 5.0, C V Raman Global University (CVRGU) Bhubaneswar [January 15-20, 2024] (Talk on January 19 & 20, 2024)
8. International Conference on Functional Materials and Polymer Technology (ICFMPT-2024) at Institute of Physics, Bhubaneswar [March 14-16, 2024] (Talk on March 16, 2024).

Prof. Dinesh Topwal

1. International conference for functional materials and polymer technology (2024)
2. First Materials Chemistry Symposium (2024)
3. National conference on electronic structure (2023)
4. Annual conference on Quantum condensed Matter (2023
5. 1st Annual Physics Symposium, IISER Berhampur (2023)

Prof. Arijit Saha

1. Topological Insulators and Topological Semimetal: Basic Introduction PQMS-2023 School, NISER Bhubaneswar, 27th May (2023)

2. A Primer on Topological Insulators: New Paradigm of Modern Condensed Matter Physics Jamia Milia Islamia (A Central University), New Delhi, 20th September (2023).
3. Higher-Order Topological Systems: Statics and Dynamics ICTP Summer School, Bukhara (Uzbekistan), 23rd September (2023).
4. Topological Superconductivity by Engineering Non-collinear Magnetism in Magnet/Superconductor Heterostructures ICIS Bangalore, 4th October (2023).
5. Topological Superconductivity in 2D by Engineering Non-collinear Magnetism in Magnet/Superconductor Heterostructures IISc Bangalore, 5th October (2023).
6. Higher-Order Topological Superconductivity in 2D Shiba Lattice IISER Bhopal, 15th December (2023).
7. Topological Insulators: A Modern Era of Quantum Condensed Matter Physics IIT (ISM) Dhanbad, 15th January (2024).
8. A Primer on Topological Superconductivity and Majorana Fermions. IIT (ISM) Dhanbad, 16th January (2024).

Prof. Arun Kumar Nayak

1. Measurement of the CP properties of Higgs boson interactions with tau leptons LHC, HQL-2023 international conference, TIFR, Mumbai.
2. Recent results on BSM searches at LHC, PHOENIX-2023 IIT-Hyderabad
3. Boosted Tau identification techniques. FTCP-2024, IISER, Pune.
4. Lectures on Basics of Monte Carlo methods and random number generation EHEP school on software development, TIFR, Mumbai, online preschool, Nov. 2023.
5. Lectures and software development sessions on Neural Network algorithms EHEP school on software development, TIFR, Mumbai, Feb. 2024.
6. CMS High Level Trigger Performance for Run 3, EPS-HEP, 2023 Talk Delivered by Sanu Varghese (student of Dr. A. K. Nayak), Hamburg, Germany.
7. Statistical methods and machine learning in high energy physics (ML4HEP) school-cum-workshop, 28 Aug. 2023 – 08 Sep. 2023, ICTS, TIFR, Bengaluru.
8. EHEP school on software development, Jan 28 – Fe. 10, 2024, TIFR, Mumbai.

Prof. Debasish Chaudhuri

1. Inertial equilibration in active particles National conference on "Time-dependent

phenomena in soft and active matter" At S N Bose National Centre for Basic Science (8-9 March 2024).

2. How activity and inertia control non-equilibrium features of active Brownian particles Physical Sciences division of IISER-Kolkata on "" on 13 March, 2024.
3. Inertial impact on active Brownian particles Int. Conference on complex fluids "Comp-Flu 2023", IIT-Madras, Chennai
4. Impact of inertia and reciprocity in the active matter Int. discussion meeting on "Active Matter and Beyond," At ICTS-TIFR Bangalore to celebrate the illustrious career of Prof. Sriram Ramaswamy
5. Collective drive by motor proteins: cargo, filaments and membranes Int. workshop on "Soft and living matter" at ICTS-TIFR, Bangalore (7-25 August 2023).
6. Impact of Ubiquitination on Kinesin-3 in Neuronal Cargo Transport: Insights from FRAP and RNAi Studies in C. elegans and Theoretical Analysis Raman Research Institute, Bangalore on 20 July 2023.
7. Collective Motion of Motor Proteins: Transport and Drive Invited seminar series at LPTM, CY Cergy Paris University, Paris, France.
8. Collective Motion of Motor Proteins: Transport and Drive Invited seminar series at LPTM, CY Cergy Paris University, Paris, France.
9. How activity and inertia control non-equilibrium features of active Brownian particles? Invited Speaker in the International workshop on "New Perspectives in Active Systems" (Active23) on 27 April 2023 at Max-Planck Institute for the Physics of Complex Systems (MPIPKS), Dresden, Germany.
10. Collective properties of motor proteins: transport and drive Biological physics seminar, at Max-Planck Institute for the Physics of Complex Systems (MPIPKS), Dresden, Germany on 12 April 2023.

Prof. Saptarshi Mandal

1. Attendent QMAT-2023 at NISER and gave a talk on extended Haldane model in November, 2023.
2. Attendent international conference at ICTP, Conference on Fractionalization and Emergent Gauge Fields in Quantum Matter and delivered a talk on our work on Kitaev model in December, 2023.

3. Attendent Young investigators meet at IISER Bhopal and delivered a talk on recent work on Kitaev-Heisenberg-Gamma model in December, 2023.

Prof. Kirtiman Ghosh

1. What LHC is telling us about the paradigms of Physics beyond the Standard Model? Int. Conference on High Energy Particle & Astroparticle Physics (ICHEPAP2023), 11–15 Dec 2023, Saha Institute of Nuclear Physics.
2. ML-Based Top Taggers: Performance, Uncertainty and Impact of Tower Tracker Data PHOENIX-2023, 18–20 Dec 2023, Indian Institute of Technology Hyderabad

Prof. Debakanta Samal

1. Emergent quantum transport due to quenched magnetic impurity scattering by antiferromagnetic proximity in $SrCuO_2/SrIrO_3$.3rd National Conference on Quantum Matter Heterostructures, IIT Hyderabad, 18th – 20th July, 2023
2. Tailoring the electronic property of iridates thin films and Cu-based layered hybrid perovskites Max Planck Institute for the Physics of Complex Systems, Dresden, 26th Sept., 2023
3. Tailoring the electronic property of iridates and cuprates thin films Max Planck Institute for Solid State Research, Stuttgart, 16th October, 2023.
4. Tailoring the electronic property in synthetic quantum materials: Iridates and cuprates thin films A seminar at Institute of Physics, Bhubaneswar, 3rd November, 2024.
5. Tailoring the electronic properties of ultrathin rock salt CuO and infinite layer cuprate interfaces CFQT2023: Crystals for Quantum Technology, INST Mohali, 11th – 12th December, 2023.
6. Emergent quantum transport due to quenched magnetic impurity scattering by antiferromagnetic proximity in SrCuO2/SrIrO3 National Conference on Electronic Structure (NCES) 2023, Gopalpur, Odisha, 15th – 17th November, 2023.
7. Tailoring the electronic property of iridates and cuprates thin films IIT Ropar, 14th December, 2024.
8. Electron correlation, magnetism and band topology in solids A seminar in PG Department of Physics, U N College of Science and Technology, Adaspur on 23rd November, 2023.
9. From atoms to solid to topological phases of matter A seminar in Department of Physics, Nayagarh Autonomous College, Nayagarh on 5th April, 2023.

Prof. Manimala Mitra

1. In WHEPP XVII (IIT Gandhinagar) January 2nd-11th, 2024 (Invited Talk)

Prof. Sanjib Agarwalla

1. Probing the Earth's Interior with Neutrinos Nuclear and Particle Physics seminar given at the Department of Physics and Astronomy, University of Iowa, Iowa City, Iowa, USA, 4thMarch 2024
2. A journey into the interior of Earth with Neutrinos Special HEP seminar given at the Physics and Astronomy Department, Northwestern University, Evanston, Illinois, USA, 12th January 2024
3. Neutrino Oscillation Parameters: Present and Future Invited talk given at the 16th Int. Conference on Heavy Quarks and Leptons (HQL2023), TIFR, Mumbai, Maharashtra, India, 29th November 2023
4. Looking inside the Earth with Neutrinos Invited talk given at the NCRAMPP-2023 conference, P.G. Dept. of Physics, Berhampur University, Berhampur, Odisha, India, 25th November 2023
5. Imaging the Earth with Atmospheric Neutrinos Invited talk given at the IRCHEP 1402 conference, School of Physics, IPM, Tehran, Iran, 22nd November 2023
6. IceCube: Highlights and Prospects Invited talk given at the GW-EM-Nu-2023 conference, TIFR, Mumbai, Maharashtra, India, 20th November 2023
7. A journey into the interior of Earth with Neutrinos Colloquium given at the Physics Department, University of Hawaii at Manoa, Honolulu, Hawaii, USA, 9th November 2023
8. Imaging the Deep Earth with Neutrinos Webinar given at the Department of Physics and Geophysics, Kurukshetra University, Kurukshetra, Haryana, India, 27th October 2023
9. Exploring Earth Matter Effects and features of PREM with IceCube Upgrade Talk given at the Fall 2023 IceCube Collaboration Meeting, Grand Rapids, MI, USA, 19th October 2023
10. Neutrino Tomography: A journey into the interior of Earth Colloquium given at the Physics Department, University of Wisconsin-Madison, Madison, Wisconsin, USA, 6th October 2023
11. Unmatched Precision on Neutrino Oscillation Parameters using Complementarity between DUNE and T2HK N3AS Online Seminar, Physics Department, University of Wisconsin-Madison, Madison, Wisconsin, USA, 8th August 2023
12. Present Status and Future Prospects of a Light eV-Scale Sterile Neutrino Invited talk

given at the Neutrino Workshop, IFIRSE, ICISE, Quy Nhon, Vietnam, 18th July 2023

13. Unprecedented Precision on Neutrino Oscillation Parameters using Synergy between DUNE and T2HK Invited talk given at the WIN 2023 conference, Sun Yat-sen University Zhuhai Campus, Zhuhai, China, 7th July 2023

14. Probing the interior of Earth using neutrino oscillations in IceCube DeepCore Invited talk given at the "Multi-messenger Tomography of Earth (MMTE 2023)" workshop, APC-Universite Paris Cite, Paris, France, 5th July 2023

15. Landscape of CP Violation in Long-baseline Experiments NPAC Seminar, Physics Department, University of Wisconsin-Madison, Madison, Wisconsin, USA, 27th April 2023

16. Neutrino Phenomenology (Two lectures) 7th Vietnam School on Neutrinos, ICISE, Quy Nhon, Binh Dinh, Vietnam, 20th to 21st July 2023

17. Neutrino Physics and Oscillations IceCube Summer School, Wisconsin IceCube Particle Astrophysics Center, Madison, Wisconsin, USA, 5th June, 2023

1.10 Conferences/Event organized

Prof. Shikha Verma

1. Int. Women's day : 1st March 2023 at Institute of Physics.

Prof. B. R. Sekhar

1. National Conference on Electronic Structure 2023 (NCES-2023)15-17 November 2023 at Gopalpur, Odisha.

Prof. Debasish Chaudhuri

1. Golden Jubilee Celebration and Workshop organization: organized an Int. Workshop on "Physics of Life: Active and Living Matter (PoL24)" at Toshali Sands, Puri, from 8-10 February 2024, as a part of the Golden Jubilee Celebration of the Institute of Physics.

2. Golden Jubilee Celebration and Hosting Int. Speaker: arranged the visit of Prof. Fernando Peruani, a Golden Jubilee colloquium speaker, and hosted him at IOP for a week in February 2024.

1.11 Externally funded Projects (India + Foreign sponsorships):

Prof. Saptarshi Mandal

1. Externally funded Projects (India + Foreign sponsorships) Yes, CRG/2021/006934

2. Visiting Students (if any): Akash Sahu (Pt. Ravishankar Shukla University, Raipur,

Chhattisgarh) complete his master thesis under my guidance from July 2023 to December, 2023.

Prof. Sanjib Kumar Agarwalla

1. DST-SERB SwarnaJayanti Project (SB/SJF/2020-21/21) Project Title: Landscape of Beyond the Standard Model Physics at Neutrino Experiments. Total cost of Project: Rs. 1,00,27,040/-

Prof. Dinesh Topwal

1. Ongoing project with CRS-UGC-DAE
2. India@DESY project for performing experiments at Petra-III Synchrotron centre. Deutsches Elektronen-Synchrotron, 22603 Hamburg, Germany

Prof. Manimala Mitra

1. Externally funded Projects (India + Foreign sponsorships) Indo-French CEFIPRA Project, 6304-2

1.12 Outreach Activities

A. M. Srivastava

1. Raman Spectroscopic investigations of Graphene Quantum Dots at National Workshop cum Hands-on Training Program on Raman Spectroscopy, NIT Rourkela, Rourkela (July 2023)
2. 'Surfaces, Nanoscience, Nanomaterials and their Applications' at Vigyan Pratibha Teachers' Training Workshop-2023 at NISER, Bhubaneswar (Sept 2023)
3. Quantum Dots and Stone Wales Topological Defects in Graphene at Int. conference on Advanced Materials for Better Tomorrow (AMBT 2023), BHU, Varanasi (Oct. 2023)
4. Nanopatterning of Surfaces: For Sensor, Device and Bio-applications at Meghnad Saha Memorial Int. Conference on Frontiers of Physics (MSMICFP-2023), University of Allahabad, Prayagraj (Nov. 2023)
5. Nanoscale patterning of Surfaces: For Sensors and Bio-applications at Frontier Symposium in Physics-2024 (FSP 2024), IISER Thiruvananthapuram (Jan. 2024)
6. Nanoscale patterning of Surfaces: For Sensors and Bio-applications at National Physicists' Conclave 2024 (NPC 2024), SRM Institute of Science and Technology, Chennai (Feb. 2024)
7. Designing Graphene Quantum dots and their Photo-response at Conference on Advanced

Functional Materials and Devices – 2024 (AFMD), SRM, Nanotechnology Research center, SRM Institute of Science and Technology, Chennai (Feb. 2024)

8. Nanopatterning of Surfaces: For Sensors, Devices and Bio-applications at Int. Conference on Sustainable Nanomaterials Integration & Organization for Energy and Environment (iSNIOE2) 2024 (March 2024)

9. PAVINARI Lecture Series by IPA on Women Physicists 'Tale of Photo 51 -Puzzle of DNA & Rosalind Franklin' (May 2023) https://tinyurl.com/4zttd59j

10. Questioning, Imagination, and Creativity in Physics Education IAPT Convention held in Jaipur, 8th Oct. 23.

11. Hawking radiation from acoustic black holes in relativistic heavy-ion collisions and in hydrodynamical flow of electrons Meghnad Saha Memorial Int. Conference on "Frontiers of Physics"(MSMICFP-2023), 23rd November, 23.

12. Detecting gravitational waves with pulsars as resonant Weber Detectors. Frontier Symposium in Physics 2024", Physics Dept., IISER, Trivendrum, 21th Jan, 24.

13. Hawking radiation from acoustic black holes in relativistic heavy-ion collisions Meeting on the physics of ALICE, CBM and STAR" (MPACS), VECC, Kolkata, 29th January, 2024.

14. Detection of Gravitational waves, a new window to the Universe One-day Research Scholar's Conclave", at IIT Dhanbad, Feb.3, 2024.

15. Life and Works of Einstein Dept. of Chemistry Ravenshaw University, Cuttack, 3rd April, 2023

16. The Universe, elementary particles, and dark energy in the "Science Movement Program" for school students at Cohen Int. school, Bhubaneswar, 8th June, 2023.

17. The Universe, elementary particles, and Black holes in the "Science Movement Program" for school teachers at Cohen Int. school, Bhubaneswar, 15th Aug. 2023.38

18. Physics of Black Holes meeting of Samanta Chandra Sekhar Amateur Astronomers' Association (SCAAA), Bhubaneswar, 10th December, 2023.

19. The Universe, elementary particles, and Black holes for school students at Cohen Int. school, Bhubaneswar, January, 2024.

20. Chandrayaan-3 National Science Day at IOP, Bhubaneswar, 28th Feb. 2024.

21. Celestial Mechanics at OCSC HBCSE meeting for the selection of Indian team for the Int. Olympiad in Astronomy and Astrophysics, May 1-3, 2023.

22. Moon and its phases for school teachers (around 2 and ½ hours) for the Vigyan Pratibha program held at NISER, 21st September., 2023.

23. Conducted night skyview session on 31st May, 2023 with Telescopes and binoculars (showing Moon craters, Venus, Mars), for IOP members.

24. Conducted night skyview session on 17th November, 2023 with Telescopes and binoculars (showing Moon craters, Saturn, Jupiter, Neptune, Uranus), for IOP members.

25. Conducted night skyview session on 15th January, 2024 with Telescopes and binoculars (showing Moon craters, Saturn, Jupiter, Neptune, Uranus), for about 300 participants at the Science Outreach program conducted by IOP at the Boudh Panchayat College, Odisha.

26. Conducted Astronomy awareness survey as part of the activity of Int. Astronomy Association at two schools in Odisha, at Odiya medium school- Chintamani Nodal Bidyapitha, Khelar, Puri, on 7th Aug.2023, and English medium school – St. Xavier's High school, Khandagiri. On 17th Aug. 2023.

27. Physics Open Discussion (POD) online sessions: Conducted following sessions: 16th Sept. 2023, 28th Oct. 2023.

Chapter 2

RESEARCH

2.1. Theoretical High Energy Physics

(S. Mukherji, S. K. Agarwalla, S. Banerjee, D. Das, M. Mitra and K. Ghosh)

The faculty members of the Theoretical High Energy Physics group at IoP (THEP@IoP) are actively researching advanced topics such as string theory, cosmology, astrophysics, Quark-Gluon Plasma, Relativistic Heavy-Ion Collisions, neutrino oscillation, and experiments related to dark matter. Additionally, they are investigating collider phenomenology within various scenarios that go beyond the Standard Model. This research is being conducted in relation to both the ongoing Large Hadron Collider (LHC) and planned experiments involving electron-positron colliders. The notable research outcomes achieved by THEP@IoP in the academic year 2021–22 are as follows:

Throughout the academic year 2022–23, Professor Ajit M. Srivastava and his fellow researchers examined modifications in pulsar pulses, attributing these changes to density fluctuations caused by phase transitions affecting the pulsar's moment of inertia. They also explored the concept of acoustic black holes within the hydrodynamic flow of electrons. Furthermore, Professor Srivastava participated in a project involving the utilization of liquid crystal textures in the liquid crystal laboratory to investigate the shapes of microorganisms.

Professor Pankaj Agrawal, in collaboration with his students, performed calculations pertaining to the electroweak corrections to the decay of the Higgs boson (H) into a pair of vector bosons (V), either a W or a Z boson. This intricate process involves one-loop diagrams featuring the VVHH coupling. Consequently, this decay procedure presents an opportunity to establish constraints on this coupling. The team conducted an in-depth analysis of the implications stemming from alterations to the HHH and VVHH couplings, mainly focusing on the influence of such modifications on the decay width.

Professor Sudipta Mukherji commenced a groundbreaking exploration by employing holography to analyze a field theory existing on a time-dependent background with a conical defect. The focal point was the Milne spacetime, wherein the Milne vacuum was represented by the adiabatic one. Within this context, the researchers successfully calculated the two-point correlators of operators that correspond to massive scalars within the AdS-Milne bulk background with the conical defect. In a separate research endeavor, Professor Mukherji and his collaborators undertook a computation involving the topological charge of the Hawking-Page transition point for black holes within the AdS space. Their approach involved utilizing the Bragg-Williams construction to determine off-shell free energy.

Professor S.K. Agarwalla and a team of collaborators conducted a comprehensive investigation concerning the capabilities of the Deep Underground Neutrino Experiment (DUNE). Their research delved into the potential for detecting deviations from maximal mixing in the second-third (23) generation neutrinos and the ability to determine the octant.

This analysis was conducted in light of the currently available data. Furthermore, the researchers explored the implications of possible non-unitary neutrino mixing (NUNM) within the context of upcoming long-baseline experiments, specifically DUNE and the T2HKK/JD+KD experiments. The latter involves a configuration with one detector located in Japan (T2HK/JD) and a second detector situated in Korea (KD). This work aimed to assess the impact of NUNM on the outcomes of these next-generation experiments. They estimated the sensitivities of these setups to place direct, model-independent, and competitive constraints on various NUNM parameters.

Dr. Debottam Das and his collaborators have calculated a few observables connecting beyond the Standard Model of particle physics where the importance of radiative corrections can help to identify the NEW physics signatures at the LHC. While gluon-initiated processes have traditionally been regarded as the primary source of di-Higgs production at the LHC experiment, the group has shown that light-quark-initiated processes can also yield significant contributions, particularly in the presence of new resonances. The team also developed a technique to calculate the two-loop corrections in the context of quantum field theory. In a definite example, focusing on an SM singlet scalar with a small leading order result, they computed the dominant next-to-leading (NLO) order corrections to produce such a scalar at the LHC. Additionally, in an ongoing collaboration, Dr. Das and his collaborators have been working on the rare decays of the Z-boson in the SM.

Dr. Manimala Mitra played a pivotal role in two intersecting areas of research: Dark Matter and collider phenomenology. Collaborating with fellow researchers, Dr. Mitra delved into the intricacies of dark matter phenomenology, specifically focusing on Weakly Interacting Massive Particles (WIMPs) and Feebly Interacting Massive Particles (FIMPs). The team's work involved an extension of the Standard Model incorporating three triplet fermions, one triplet scalar, and one singlet fermion. This extended model had the potential to simultaneously account for neutrino masses and dark matter. Moreover, the researchers delved into the possibility of the next-to-lightest odd particle within the triplet becoming long-lived. This aspect opened avenues for probing this particle using the proposed MATHUSLA detector. The combined efforts of Dr. Mitra and her collaborators significantly contributed to advancing our understanding of both dark matter and collider physics, uncovering potential complementarity between these two fascinating realms.

Dr. Kirtiman Ghosh's research group is dedicated to investigating the underlying nature of Beyond the Standard Model (BSM) scenarios. Their primary mission revolves around comprehending the phenomenology of various BSM scenarios, particularly within the context of collider experiments, as well as other experimental domains, including neutrino scattering and oscillation, Dark Matter direct/indirect detection, and lepton flavor violation. A central focus of their work is to discern the interconnectedness and mutual benefits between these

diverse experimental approaches. Dr. Ghosh's group has substantially contributed to advancing our understanding of BSM physics. These scenarios include the incorporation of exotic leptons within large gauge multiplets, the investigation of triplet-like Higgs bosons, the analysis of Scalar Leptoquarks, and the exploration of doubly-charged Higgs bosons.

2.1.1 Research Contribution by Prof. S. K. Agarwalla and his Group-Flavor-dependent long-range neutrino interactions in DUNE & T2HK : alone they constrain, together they discover

In this paper, we study the sensitivity to new flavor-dependent long-range Interactions mediated by ultra-light mediators, with masses below 10-10 eV, arising from gauged lepton number symmetries Le - Lm, Le - Lt, or Lm - Lt. We find that DUNE and T2HK may strongly constrain long-range interactions, setting new limits on their coupling strength for mediators lighter than 10-18 eV. However, if the new interactions are subdominant, then both DUNE and T2HK, together, will be needed to discover them, since their combination lifts parameter degeneracies that weaken their individual sensitivity. This work got published in the international referred journal JHEP 08 (2023) 101.

Present and future constraints on flavor-dependent long-range interactions of high-energy astrophysical neutrinos

Neutrinos may conceivably undergo interactions with matter beyond those contained in the Standard Model. Flavor-ratio of astrophysical neutrinos can be used to study the new flavor-dependent long-range interactions between neutrinos and matter, resulting from lepton-number symmetries Le - Lm, Le - Lt, or Lm - Lt. In this work, using the present-day and future sensitivity of high-energy neutrino telescopes - IceCube, IceCube-Gen2, Baikal-GVD, KM3NeT, P-ONE, and TAMBO - and of oscillation experiments - DUNE, T2HK, and JUNO - we estimate the constraints that could be placed on the coupling strength of these interactions. This work got published in the international referred journal JHEP 08 (2023) 113.

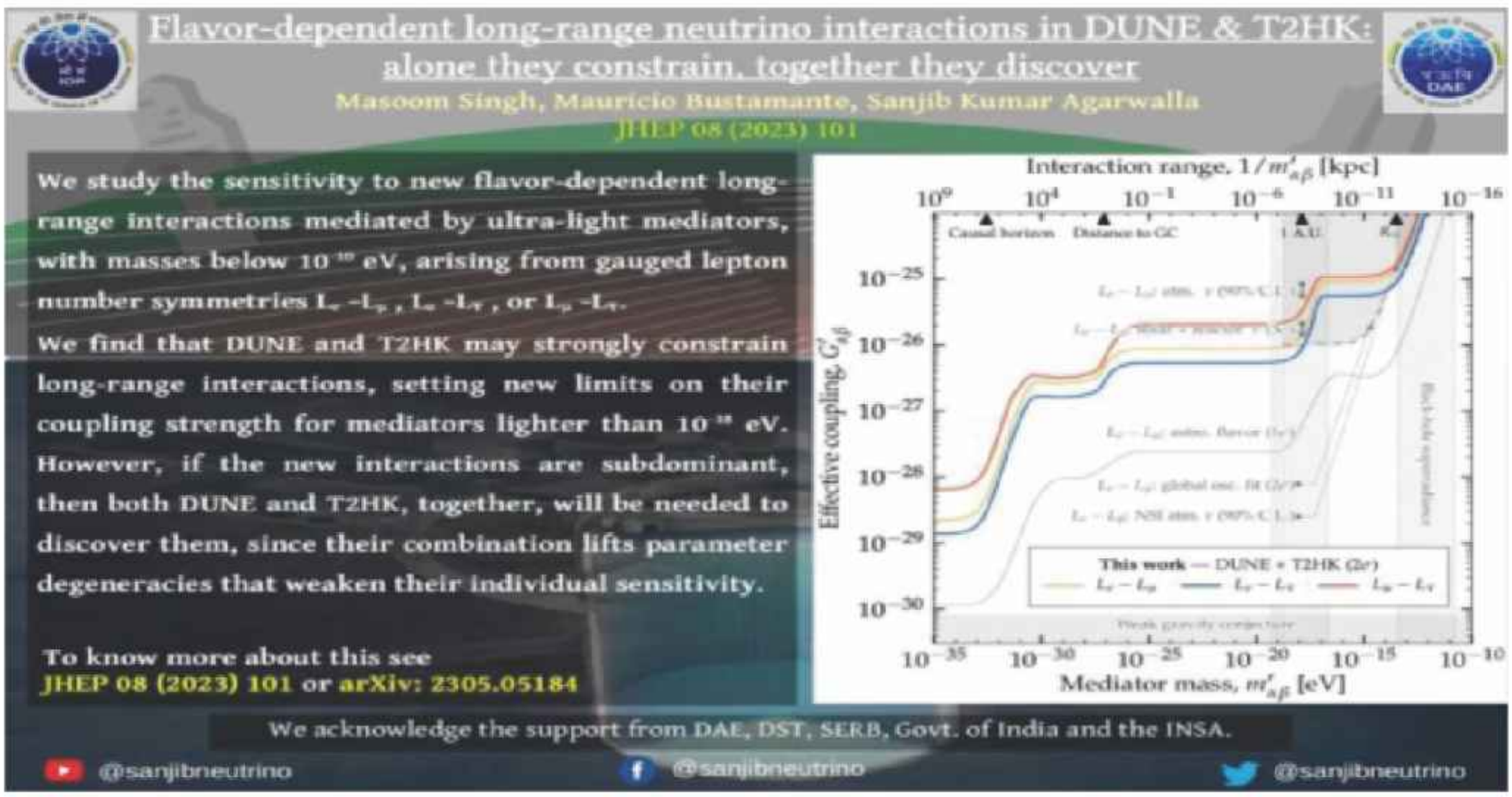
Constraining Lorentz Invariance Violation with Next-Generation Long-Baseline Experiments

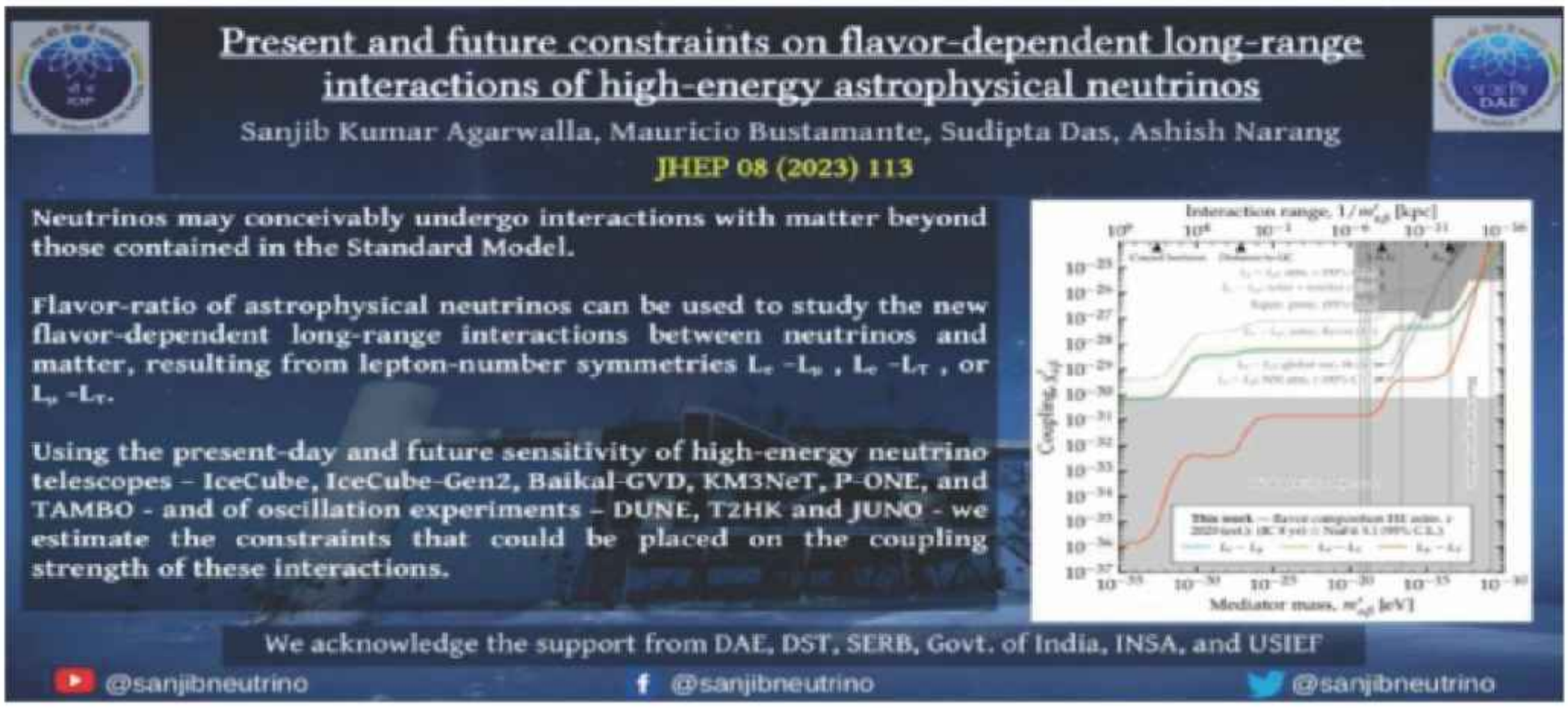
Lorentz Invariance Violation (LIV) is allowed in unified theories such as string theory and loop quantum gravity at the Planck scale (1019 GeV). The parameters governing LIV in the low-energy effective field theory can be CPT-violating or CPT-conserving. We place competitive constraints on both the CPT-violating and CPT-conserving LIV parameters using the long-baseline experiments, DUNE and T2HK in isolation and combination. We find that due to access to a longer baseline and multi-GeV neutrinos, DUNE has a better reach in probing all the LIV parameters. T2HK, dealing with only sub-GeV neutrinos becomes almost insensitive to the CPT-conserving LIV parameters. The degeneracies between è23, dCP, and the LIV phases lead to the deterioration of the bounds for standalone DUNE and T2HK.

However, when we combine the prospective data from DUNE and T2HK, these degeneracies disappear. This work got published in the international referred journal JHEP 07 (2023) 216.

2.1.2 Enhancing Sensitivity to Leptonic CP Violation using Complementarity among DUNE, T2HK, and T2HKK

In this work, we explore in detail the possible complementarity among the on-axis DUNE and off-axis T2HK experiments to enhance the sensitivity towards leptonic CP violation by suppressing the (è23 - dCP) degeneracy. We find that both DUNE and T2HK together are needed to establish CP violation at 5 for at least 60% choices of CP in the range of -180° to 180°, irrespective of the neutrino mass ordering and the value of atmospheric mixing angle in Nature. This work got published in the international referred journal Eur.Phys.J.C 83 (2023), 694.





Constraining Lorentz Invariance Violation with Next-Generation Long-Baseline Experiments

Sanjib Kumar Agarwalla, Sudipta Das, Sadashiv Sahoo, Pragyanprasu Swain

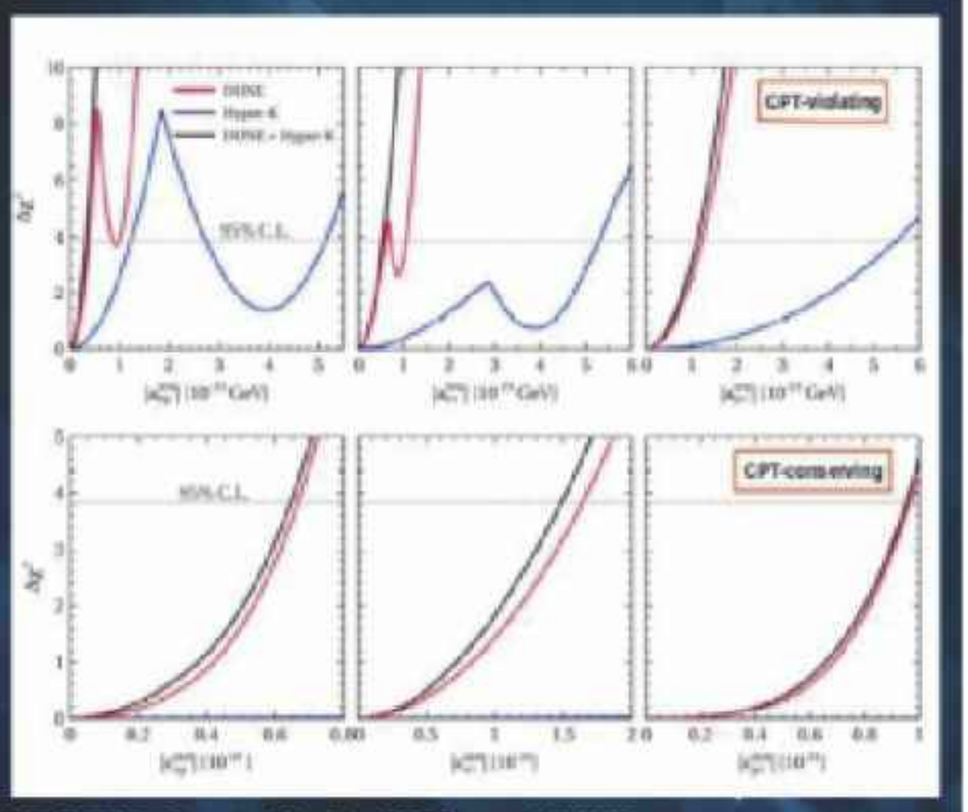
Journal of High Energy Physics 07 (2023) 216

Lorentz Invariance Violation (LIV) is allowed in unified theories such as String theory and Loop quantum gravity at Planck scale (~ 10^{19} GeV). The parameters governing LIV in the low energy effective field theory can be CPT-violating or CPT-conserving.

We place competitive constraints on both CPT-violating and CPT-conserving LIV parameters using the long-baseline experiments, DUNE and Hyper-K in isolation and combination.

We find that due to access to a longer baseline and multi-GeV neutrinos, DUNE has better reach in probing all the LIV parameters. Hyper-K, dealing with only sub-GeV neutrinos becomes almost insensitive to the CPT-conserving LIV parameters.

The degeneracies between θ_{23}, δ_{CP}, and the LIV phases lead to the deterioration of the bounds for standalone DUNE and Hyper-K. However, when we combine the data from DUNE and Hyper-K these degeneracies disappear.



We acknowledge financial support from the DAE, DST, DST-SERB, Govt. of India, INSA, and USIEF.

@sanjibneutrino @sanjibneutrino @sanjibneutrino

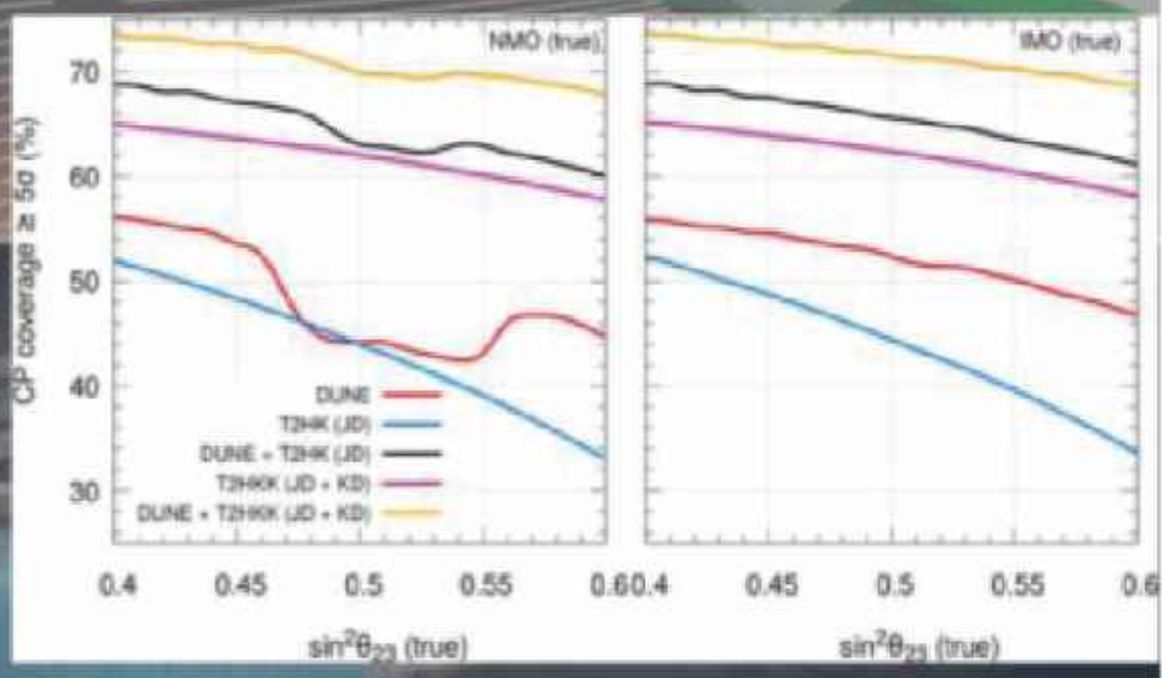
Enhancing Sensitivity to Leptonic CP Violation using Complementarity among DUNE, T2HK, and T2HKK

Sanjib Kumar Agarwalla, Sudipta Das, Alessio Giarnetti, Davide Meloni, & Masoom Singh

EPJC 83 (2023) 694

In this work, we explore in detail the possible complementarity among the on-axis DUNE and off-axis T2HK experiments to enhance the sensitivity towards leptonic CP violation by suppressing the (θ_{23} – δ_{CP}) degeneracy.

We find that both DUNE and T2HK together are needed to establish CP violation at 5σ for atleast 60% choices of $\delta_{CP} \in [-180°, 180°]$, irrespective of the mass ordering and atmospheric mixing angle in Nature.



To know more about this see:

Eur.Phys.J.C 83 (2023) 694 or arXiv: 2211.10620

We acknowledge the support from DAE, DST, SERB, Govt. of India, INSA, and USIEF.

@sanjibneutrino @sanjibneutrino @sanjibneutrino

2.1.2 Research Contribution by Prof. Debottam Das and his Group

The lightest neutralino is a good Dark Matter (DM) candidate in the R-parity conserving Minimal Supersymmetric Standard Model (MSSM). In this work, we consider the light Higgsino-like neutralino as the Lightest Stable Particle (LSP), thanks to rather small Higgsino

mass parameter μ. We then estimate the prominent radiative corrections to the neutralino-neutralino-Higgs boson vertices. We show that for Higgsino-like ~÷0, these corrections can significantly influence the spin-independent direct detection cross-section, even contributing close to 100% in certain regions of the parameter space. These corrections, therefore, play an important role in deducing constraints on the mass of the Higgsino-like lightest neutralino DM, and thus the μ parameter. In the other work, for a well-tempered Bino-Higgsino DM, after including the renormalized one-loop vertices, the spin-independent DM-nucleon cross-sections may be enhanced up to 20% compared to its tree-level results.

We study the rare decay process of Z boson into photon, accompanied by a CP-even or CP-odd scalar. We present the analytical delineation of the processes through the model-independent parametrizations of the new physics couplings and, finally, consider the Next-to-Minimal Supersymmetric Standard Model to mark out the parameter space where the branching fraction can have the maximum value. As a part of the necessary phenomenological and experimental cross-checks, we aim to fit the anomalous magnetic moment of the muon and W boson mass anomaly through the supersymmetric contributions. We also find that the decays Z to H, ã, A, ã can serve as an excellent complementary test to BRh SM to Z ã . In fact, to facilitate future searches, we unveil a few benchmark points that additionally satisfy the deviation of BRh SM to Z ã from the SM value based on the recent measurements of ATLAS and CMS. Future proposals such as ILC, CEPC, and FCC-ee are anticipated to operate for multiple years, focusing on center-of-mass energy near the Z pole. Consequently, these projects will be capable of conducting experiments at the Giga-Z (10^{9} of Z bosons) and Tera-Z (10^{12} of Z bosons) phases, which may probe the aforesaid rare decay processes, thus the model as well. These unconventional yet complementary searches offer different routes to explore the super symmetric models with extended Higgs sectors like NMSSM.

2.1.3 Research Contribution by Prof. Manimala Mitra and her Group Fermionic dark matter in Dynamical Scotogenic Model

In JHEP 08 (2023) 130, we explored dynamical scotogenic model. In the Dynamical Scotogenic Model, the global B " L symmetry is supposed to be broken spontaneously resulting in a massless Goldstone boson called majoron, and massive right handed neutrinos which participate in the generation of light neutrino massses at one-loop. One of them being the lightest stable particle can be a thermal dark matter candidate. We discuss how the dark matter phenomenology differs from the original Scotogenic model, taking into account all the constraints coming from the observed neutrino masses and mixing, lepton flavor violations such as ì '! eã, ì '! eJ, astrophysical and cosmological observations of stellar cooling and Neff, as well as collider signatures such as Higgs invisible decays. We find that the dark matter annihilation to majorons plays an important role to produce the right relic abundance.

Type-II see-saw at ì+ ì" collider

In Phys.Lett.B 844 (2023) 138105, we explored Type-II seesaw at the muon collider. Doubly-charged Higgs bosons have extensively been searched at the LHC. In this work, we study the sensitivity reach of the doubly-charged scalar in muon collider for the well-known Type-II seesaw scenario. First, we perform a cut-based analysis to predict the discovery prospect in the muon collider operating with 3 TeV center of mass energy. In addition to this, we have also performed a multivariate analysis and compare the cut-based result with the result obtained from the multvariate analysis. We find that the cut-based analysis is more significant as compared to the multivariate analysis in the large doubly-charged scalar mass region. We predict that a doubly-charged scalar mass, upto 1450 GeV can be probed with 5ó significance for center of mass 3 TeV and integrated luminosity 1000 inverse-fb.

An alternate left-right symmetric model with Dirac neutrinos

In Eur.Phys.J.C 83 (2023) 6, 480, we study a different variant of left-right symmetric model, incorporating Dirac type neutrinos. In the absence of the bi-doublet scalars, the possibility of a universalseesaw type of mass generation mechanism for all the Standard Model charged fermions have been discussed. The model has been constructed by extending the Standard Model particle spectrum with heavy vector-like fermions as well as different scalar multiplets. We have shown that this model can generate non zero neutrino mass through loop mediated processes. The parameters which are involved in neutrino mass generation mechanism can satisfy the neutrino oscillation data for both normal and inverted hierarchy. The lightest charged Higgs plays a crucial role in neutrino mass generation mechanism and can have mass of We have systematically studied different constraints which are relevant for the charged Higgs phenomenology. In addition to that we also briefly discuss discovery prospects of the charged Higgs at different colliders

2.1.4 Research Contribution by Prof. Kirtiman Ghosh and his Group

Our research group, comprising myself and my Ph.D. students Avnish, Vandana Sahdev, Rameswar Sahu, and Debabrata Sahoo, is dedicated to studying the phenomenology of various Beyond Standard Model (BSM) scenarios. We focus on their implications in collider experiments, neutrino scattering and oscillation, Dark Matter direct/indirect detection, and lepton flavor violation experiments. Throughout 2023-24, we have made significant contributions to the development and understanding of different BSM scenarios. A summary of our key research outcomes is provided below.

Radiative Neutrino Mass with Electroweak Scale Majorana Dark Matter in the Scotogenic Model:

The presence of non-zero neutrino mass and dark matter (DM) challenges the completeness of the Standard Model (SM) of particle physics. The Scotogenic model offers a straightforward extension to address these issues by incorporating three isospin singlet right-handed neutrinos and one doublet scalar, all of which are odd under a Z2 symmetry. In this model, neutrino masses and mixings arise from the Weinberg operator induced at the one-loop level. The model's particle spectrum includes several weakly interacting stable massive particles, making them potential DM candidates. In this study, we consider the lightest right-handed neutrino as the DM candidate.

The Yukawa couplings responsible for the observed flavor mixings in the neutrino sector also induce flavor violation in the charged lepton sector of the SM, thus facing stringent constraints from charged lepton flavor violating (CLFV) observables. These same Yukawa couplings also influence DM annihilation in the early universe, determining the DM relic density. Our work addresses the tension between CLFV constraints and the measured DM relic density by employing a parameterization that reduces the relevant phenomenological parameters to three, thereby enhancing detection prospects at collider experiments. We explore the parameter space consistent with current CLFV bounds, the observed DM relic density, and the absolute neutrino mass limit. To search for these scenarios, we identify two promising signals at proposed lepton colliders: the mono-photon plus missing energy and di-lepton plus missing energy signals. We study the collider phenomenology of these signatures and estimate the 5ó detection luminosity required for center-of-mass energies of 500 GeV and 1 TeV.

ML-Based Top Taggers: Performance, Uncertainty, and Impact of Tower & Tracker Data Integration:

Machine learning algorithms can discern intricate features directly from raw data. We evaluated the performance of top taggers based on three machine learning architectures: a Boosted Decision Tree (BDT) using jet-level variables (high-level features, HLF), a Convolutional Neural Network (CNN) trained on jet images, and a Graph Neural Network (GNN) trained on the particle cloud representation of a jet, utilizing the 4-momentum (low-level features, LLF) of the jet constituents as input. Our results show a significant performance enhancement across all three classifier types when trained on combined data from calorimeter towers and tracker detectors. The high resolution of tracking data not only improved classifier performance in the high transverse momentum region but also provided valuable information on the distribution and composition of charged and neutral jet constituents. This helped identify the quark/gluon origin of sub-jets, thereby enhancing top tagging efficiency.

LLF-based classifiers, such as CNNs and GNNs, demonstrated notably better

performance compared to HLF-based classifiers like BDTs, particularly in the high transverse momentum region. However, the performance of LLF-based classifiers trained on constituent 4-momentum data showed substantial dependency on the jet modeling within Monte Carlo generators. To address this, we developed composite classifiers by stacking a BDT on top of a GNN/CNN. These composite classifiers not only improved the performance of LLF-based classifiers but also mitigated uncertainties from the showering and hadronization models used in event generation. We conducted a comprehensive study on how the fat jet's reconstruction and labeling procedures affect classifier efficiency. Additionally, we examined the variation in classifier performance with respect to the transverse momentum of the fat jet, providing a detailed analysis of their efficacy across different momentum ranges.

Leptoquark Searches at the Collider Experiments:

We present search strategies for two distinct leptoquark models at current and future colliders. The first model, which includes a singlet and a doublet scalar leptoquark, can generate neutrino mass at one-loop and contribute to the muon g"2 experimental measurement. We examine the signatures of this model in benchmark scenarios that simultaneously meet neutrino mass and oscillation data, address the muon g"2 excess, and comply with CLFV bounds. These signatures are studied through pair production at the LHC/FCC, highlighting complementary final states that differentiate the leptoquark mass eigenstates. A notable mixing between the singlet and doublet leptoquarks can be investigated through asymmetric pair production.

2.2. Theoretical Nuclear Physics (S. K. Patra and P. K. Sahu)

Institute of Physics have worked on different areas of nuclear physics, such as finite nuclei, nuclear matter, and neutron stars. Starting from the finite nuclei, we mainly explore the properties such as nuclear structure and reaction dynamics of different atomic nuclei. Some of the structural properties, such as binding energy, charge radius, magic numbers, two-neutron separation energy, symmetry energy, etc., in detail, have been calculated. Nuclear reactions, including alpha and beta decays, clusterization, fissions, etc., were determined with the help of relativistic to non-relativistic energy density functionals.

The nuclear matter properties such as binding energy per particle, energy density, pressure, effective mass, symmetry energy, and its different coefficients, etc., in different environments, either in the presence of dark matter or temperature from very low density to high density. The nuclear matter, finite nuclei, and neutron star equation of states are calculated with the well-known relativistic mean-field (RMF) model. We have developed our two functionals such as G3 and IOPB-I and applied them from finite nuclei to the neutron star. Our extended RMF model well reproduced the properties of different systems, such as finite nuclei to the neutron star.

Recently, we have extended our domain and explored the neutron star properties by adding dark matter. Some of these neutron star properties, such as its equation of states, mass, radius, tidal deformability, the moment of inertia, cooling scenario, inspiral properties of the binary neutron star, oscillations properties, different curvature parameters, etc. are calculated. Also, we have added temperature to see its effects on the thermal conductivity, emissivity, specific heat, thermal index, etc. are computed with different fractions of dark matter inside it.

The gravitational wave properties are also explored using the post-Newtonian method for different masses of the binary neutron star. In the inspiral stage, some well-known properties such as frequency, polarisability, phases of the two binary, etc., have been calculated for dark matter admixed neutron stars.

Another method known as Coherent Density Fluctuation Model (CDFM) is applied by our group to calculate the surface properties of finite nuclei as well as of Neutron Star. Here, we evaluate the symmetry energy, neutron pressure and there surface properties.

2.2.1 Research Contribution by Prof. S. K. Patra and his Group

In our investigation of ALICE data, we have observed a correlation between event multiplicity and the ratios of yields for different pairs of hadrons produced in proton-proton and proton-lead collisions at LHC energies. The variation is not confined to the yields of (multi-)strange hadrons relative to pions; rather, it encompasses notable enhancements in the yield ratios for non-strange hadrons (p/ð) and hadrons with identical strangeness (Ë/K0s) as the charged-particle multiplicity of the event increases. These observed variations are predominantly contributed by the masses of the individual hadrons and the rest masses of their valence quarks. Expanding to introduce heavy flavor results, we shed light on the previously unexplored mass-dependent correlation between event multiplicity and yield ratios of hadrons. This enhancement, reminiscent of the well-established strangeness enhancement, is now observed in the ratios of D mesons to pions and Ë+c baryons to Lambdas in proton-proton collisions at LHC energies.

The charge fluctuations have already been analysed by STAR, ALICE and CMS experiment using a robust variable known as dynamical charge fluctuations. We have proposed the higher orders of this variable for the first time using SMASH model. The higher order fluctuations measure provide the information about the strength of higher order correlations which is subject to change with particle multiplicity in an ensemble. After analysing at the higher energies (200 and 62.4 GeV), the observable was analysed for lower energies (19.6, 14.5, 11.5, 9.2 and 7.7 GeV) to complete all the energies in STAR BES program. The results from all the eight energies for the second, third and fourth orders of charge fluctuations were

completed. The statistical error was calculated using Boot Strap Method using seventy samples. The values were within the marker size. The results showed the behaviour of this observable at different centralities and energies. It was observed that the higher orders (third and fourth) contain higher order of cross-correlations terms, hence they can amplify the signal in heavy ion collisions. It was also observed that unlike the second order, the higher orders were more sensitive to detector effects.

For spherically symmetric nucleus, Wood-Saxon potential proves to be highly suitable in giving nucleons distribution within a nucleus. Incorporating shape modification in Wood-Saxon, earlier attempts were made to explain observables in the deformed nucleus collisions such as Uranium(U). In this investigation, we checked feasibility of an alternate approach, Nilsson potential or Modified Harmonic Oscillator using one of the heavy-ion simulation model. Our study shows that, the results from Nilsson potential are comparable with that of Modified WoodSaxon, within the current model formalism.

The meson exchange interaction based on relativistic mean-field (RMF) theory has been introduced in the hadron resonance gas (HRG) model, called the interacting HRG (iHRG) model. This model can explain the experimental data at finite temperature (T) with finite chemical potential (iB) and finite temperature at vanishing chemical potential. The nuclear matter equation of state also can be explained at zero temperature with finite baryon density (finite chemical potential) due to attractive and repulsive interactions between the hadrons in the iHRG model. This study's results are compared with those from other heavy-ion transport models and experimental data.

We also study the Fermionic dark matter inside the neutron star, which couples to nucleons through Higgs field via effective Yukawa coupling. The neutron star matter consists of leptons, nucleons, and hyperons in the relativistic chiral sigma model. If the dark matter composition is increased, then the neutron star gets more compact, and hence the size and mass reduce significantly.

2.2.2 Research Contribution of P. K. Sahu and his group

Gas Electron Multipliers (GEM) detectors possess high rate capability and resolution compared to the detector based on the wire chamber or tracking drift chamber principle. A systematic study of the absolute gain of a prototype GEM detector at different gas flow rates is carried out. The gain uniformity across the detectors, which is important for a quantitative understanding of the functioning of different areas of the detector, is also examined. The active surface area (10 cm × 10 cm) of the detector is divided into 16 zones of equal area (2.5 cm × 2.5 cm), and each zone is irradiated with a collimated Fe55 X-ray source. Absolute gain is

calculated using the measured anode current from the detectors. For this purpose, a pre-mixed gas mixture of Ar: CO2 in the ratio of 80:20 is used in the range of 5–27 SCCM flow rate. In addition, for a fixed flow rate of 21 SCCM, the dependency of gain uniformity on gas flow is investigated by reversing the gas flow direction inside the gas chamber.

We have done an investigation for GEM signal and Time resolution using a numerical analysis method. The Garfield++ simulation package is used here with a known field solver, ANSYS. To examine the impacts of gas mixture and electron transport characteristics inside the detectors, two other software, Magboltz, and Heed, are utilized. By exploring the impacts of detector geometry, electric fields, incoming particle energy, and gas mixture characteristics, we tried improving GEM detectors for higher temporal resolution. A single GEM detector is investigated with two radiation sources, i.e., a 5.9 KeV Fe55 X-ray photon and cosmic muons with energies ranging from 1 MeV -1 TeV. For Ar:CO2 gas mixture for a particular set-up, a minimum temporal resolution up to around 4 ns is recorded. By examining the various detector geometries and field settings, this number can be reduced even more. A significant result in lowering the temporal resolution is achieved by the change of drift field and percentage of the ionization component in the gas mixture. The admixture of O2 and N2 in the gas medium also improves the detector time performance. It is also observed that, the initial particle energy has little effect on the timing accuracy of the detector.

2.3. Experimental High Energy Physics (P. K. Sahu and A. K. Nayak); Contributions to the CMS experiment at CERN-LHC:

The Compact Muon Solenoid (CMS) is a general-purpose detector at the Large Hadron Collider (LHC). The CMS group at IOP made major contributions to the measurement of Higgs boson CP properties in its decay to a pair of tau leptons. The angle between the decay planes of the two tau leptons is exploited to probe the CP nature of the Higgs boson. The analysis with full Run-2 data at 13 TeV provided a measured value of the CP mixing angle to be (-1 +/- 19) degree at 68% confidence level and excludes a pure CP-odd state by 3 standard deviations. The results are published in JHEP.

In addition, we are leading an analysis for the search of a charged Higgs boson decaying to a charm and a strange quark, where the charged Higgs originates from the decay of a top quark. The analysis involves kinematic fitting to fully reconstruct the top quark pair and multivariate methods to discriminate signal from backgrounds. The analysis with full Run-2 data is in advance stage and expects significant improvement with respect to previous bound. We are also involved in the analysis for the search for a pseudo-scalar Higgs boson that can decay to a Z boson and the Standard Model like Higgs boson. The final state consists of two leptons (electron/muon) from Z decay and two tau leptons from Higgs decay. The analysis is

being performed with full available 13 TeV data. Furthermore, we are starting to work on an analysis for the search of a Lepto-Quark decaying to a top quark and a tau lepton.

Our group plays leading role in the development of CMS high-level trigger system for LHC Run-3, which started from 2022. We are involved in leading the STEAM group under Trigger Coordination for last three years. Sanu Varghese (student) was appointed as STEAM group convener from Sep 2022 to Aug 2024. We have been consistently performing trigger rate studies for last two years using high instantaneous luminosity data in order to validate menus and prepare trigger pre-scales for the trigger menus being developed and deployed for data taking for the last two years. Also, we have developed various analysis frameworks for these purposes. We have also been leading the development of tau reconstruction and identification at the HLT level and development of tau HLT paths for Run-3 data taking and their performance measurement in Run-3 data. Vinaya Krishnan (student) is a convener of the tau-trigger group for last two years. We are contributing to the upgrade of the CMS silicon-strip tracker detector, for CMS phase-II upgrade. We have assembled a DAQ set up for the functional test of a single silicon-strip tracker detector module. Currently, in collaboration with other institutes, we are trying to set up a multi-module testing facilities.

We have studied and developed, using Monte-Carlo simulated data, machine learning techniques to reconstruct the invariant mass of the heavy gauge bosons (Z' and W'), where these heavy particles decay to final states with tau leptons. It is difficult to reconstruct full invariant mass from decay products in these final states because of the missing neutrinos. However, our ML studies show promising results in reconstructing the invariant mass as well as improving the mass resolution.

2.3.1 Research Contribution by Prof. Aruna K Nayak and his Group Physics analyses using pp collision data recorded by the CMS experiment at CERN-LHC

An analysis is carried out for the search of a charged Higgs boson decaying to a charm and a strange quark, where the charged Higgs originates from the decay of a top quark. The analysis involves kinematic fitting to fully reconstruct the top quark pair, where the final state consists of one lepton (electron or muon) and at least four jets of which at least two jets are b-tagged. Higgs to cs decay is identified using c-jet tagging techniques. To further improve the analysis sensitivity, multivariate methods, such as boosted decision trees (BDT) are used for better discrimination of signal from backgrounds. The BDT utilizes kinematic distributions, distributions of the b and c-tagging discriminators, as well angular correlations of the decay products of the charged Higgs and the top quark. The analysis with full Run-2 data is expected to provided stringent upper limit on the branching fraction of top quark decaying to charged Higgs boson. Another analysis is being carried out for the search of a lepto-quark decaying to a

top quark and a tau lepton at CMS. The signal consists of a pair of lepto-quarks, which are then decaying to two top quarks and two tau leptons. The final state considered in this analysis is two fully hadronic decaying top quarks leading to 6 jets of which at least two are b-tagged and two hadronic decaying tau leptons. The analysis is challenging due to fully hadronic final state and having large irreducible backgrounds at LHC. The analysis is carried out with full run-2 data.

2.3.2 Contributions to the development of high-level trigger and detector upgrade in the CMS experiment

Our group is involved in the development of CMS high-level trigger system for LHC Run-3, which started from 2022. We are involved in leading the STEAM group under Trigger Coordination for last four years. We have been consistently performing trigger rate studies for last 3 years using high instantaneous luminosity data in order to validate trigger paths and prepare pre-scales for the paths being developed and deployed for data taking for the last two years. In addition, various analysis frameworks have been developed for these purposes.

India-CMS is contributing significantly to the phase-II upgrade of the CMS detector for HL-LHC. In this effort, we are contributing to the upgrade of the CMS silicon-strip tracker detector. A DAQ set up has been assembled for the functional test of a single silicon-strip tracker detector module, which is currently being used for single-module test. Now a multi-module functional test system is being setup using a microTCA crate and FC7-card based readout system, which will be used to test multiple modules together during the assembly and ladder integration test.

2.3.3 Machine Learning studies

We have studied and developed, using Monte-Carlo simulated data, machine learning techniques to reconstruct the invariant mass of the heavy gauge bosons (Z' and W'), where these heavy particles decay to final states with tau leptons. It is difficult to reconstruct full invariant mass from decay products in these final states because of the missing neutrinos. We employed deep neural network and a modified adversarial network to study the invariant mass reconstruction. Our ML studies showed promising results in reconstructing the invariant mass as well as improving the mass resolution. The results have been published in European Physics Journal C. The study is being extended to charged Higgs boson decaying to tau lepton and neutrino.

2.4 Quantum Information

Research Contribution by Prof. Pankaj Agrawal and his group

The quantum information group has been working in the area of Quantum Correlations, Quantum Nonlocality and Contextuality, Quantum Communication protocols, and Quantum

Cryptography. In 2022, the Nobel Prize in physics was awarded in this area. The Nobel Prize recognized efforts to take quantum weirdness out of philosophical discussions and to experimental demonstration and some practical applications. The award recognized work in testing Bell inequalities and implementation of several quantum communication protocols.

The group has proposed new Bell inequalities and suggested a new way to test the securities of quantum cryptographic protocols. The proposed Bell inequalities are minimal-scenario multipartite Bell inequalities and require minimal resources to test the nonlocality of a pure multipartite state. The group has also proposed new uncertainty relations that are suitable for entangled systems. These relations depend on the measures of entanglement. These relations for a pure entangled state also give a new way to test security of the Eckert type quantum cryptographic protocols.

2.5 Experimental Condensed Matter Physics (K. K. Nanda, S. Varma, T. Som, B. R. Sekhar, D. Topwal, S. Sahoo and D. Samal)

IoP Experimental Condensed Matter Physics Group is pursuing several research programmes which are based on ion accelerators, thin films, surface and interface science, highly correlated electron systems, two-dimensional materials, quantum materials. Some of the major research areas include energy research, resistive switching and its use to emulate bio-synaptic behavior for in-memory computing, etc. Our main goal is to investigate and understand the structure-property correlation of solids. Different techniques are employed for synthesis and modification of solids such as ion implantation, pulsed laser deposition, sputter deposition, molecular beam epitaxy, high temperature solid state reaction, and chemical route. Different physic-chemical properties of materials are investigated using advanced characterization techniques, viz. high resolution x-ray diffraction, field emission gun-based scanning electron microscope, atomic force microscope, SQUID-VSM, physical properties measurement system, high-resolution Raman spectrometer, current-voltage spectroscopy, optical spectroscopy etc.

2.5.1 Research Contribution by Prof. Shikha Varma and her Group Photophysics of Copper-doped ZnO nanorods :

The effect of copper doping in modifying the photo-physics properties of ZnO nanorods has been investigated. During the process of Cu doping, although the nanorods retain their crystalline orientation, lattice expansion, defect generation and morphological modifications are observed. PL results indicate that although the pristine ZnO nanorods are in photoluminescence ON state with highest PL intensity, a PL OFF state is present after one percentage of Cu incorporation.

CuSe Nanostructures for Sensing Applications:

Nanostructured CuSe have been studied for their sensing behavior by understanding their crystalline structure, phase, composition, and band gap properties. At ambient conditions, CuSe nanostructure-based sensors demonstrate rapid response and recovery time, long-term stability and selectivity towards ammonia gas sensing. A good repeatability, owing to its distinct structural morphology, has also been investigated.

Role of Sb ion implantation on the optical and structural properties of rutile TiO2 (110):

The synergetic influence of Sb ion implantation on the optical and structural properties of single crystal rutile TiO2 (110) has been investigated. The Implantation was carried out at various fluences using 2 MeV Sb ions. Studies reveal the occurrence of an ion-induced annealing process which is responsible for the healing of defect states in the absence of any thermal treatment. This effectively improves photo absorption properties and is important for photo catalytic applications

DFT studies on the Optical behavior of Graphene Quantum dots:

DFT studies have been carried out to understand the behavior of size dependent optical activity in Graphene Quantum Dots (GQDs). These results are being studied in conjugation with the results obtained via Raman and UV-Vis experiments on GQDs.

2.5.2 Research Contribution by Prof. T. Som and his Group

Ion-induced nanoscale patterning of materials and their functionalization

a) Performance optimization of microwave-coupled plasma-based ultra-low energy ECR ion source for silicon nano structuring and application

b) Yellow-to-deep red emissive band formation on optically porous nano patterned silica

c) Enhanced transverse optical mode with asymmetric reflectivity on GaSb through low energy Kr-ion induced highly-ordered nanoscale self-organization

Growth of thin films for applications in optoelectronics

a) Oxygen-mediated tunability in physicochemical properties of RF sputtered vanadium pentoxide thin films towards energy harvesting.

b) Growth angle-mediated tuning of electronic properties at the V2O5-x/Si interface: Implications towards heterojunction solar cell.

c) Growth angle-dependent tunable work function and optoelectronic properties of Wox thin films.

Emulation of bio-synaptic behavior at nanoscale using memristors for potential applications in neuromorphic computing

a) Bipolar resistive switching-based synaptic memory in mixed-phasic transparent vanadium oxide thin films: Role of stoichiometry

b) Excellent bio-synaptic behaviour in nanostructured WO_{3-x} memristors

c) Growth angle-dependent resistive switching and synaptic behaviour in Cu-O thin-films

d) Enhanced memory and learning capabilities in p-n hetero-structured oxide memristors

e) Improved multi-level analog and digital resistive switching in CuOx/WO3-x memristors

f) Nanoscale resistive switching in pulsed laser deposited TiOx thin films: A parametric investigation through scanning probe microscopic method

g) Artificial nociceptor realized in Au-ion implanted TiOx memristors at nanoscale

h) Controlled bi-directional threshold switching behaviour through ion implantation for random numbe generation applications

i) Understanding the role of electrical and thermal stress on the resistive switching behaviour of TiOx memristor probed via cAFM technique: A simulation perspective

j) Tailoring resistive switching properties of Ga_2O_3: Role of growth parameters

k) Investigation of sputter-grown TiN-based memristive devices for non-volatile memory applications: Role of nitrogen flow rate

l) Metal phthalocyanine-based molecular memristor with multilevel resistive switching for electronic synapse application

Ion implantation in diamond and related materials to create nitrogen-vacancy centres for quantum sensors

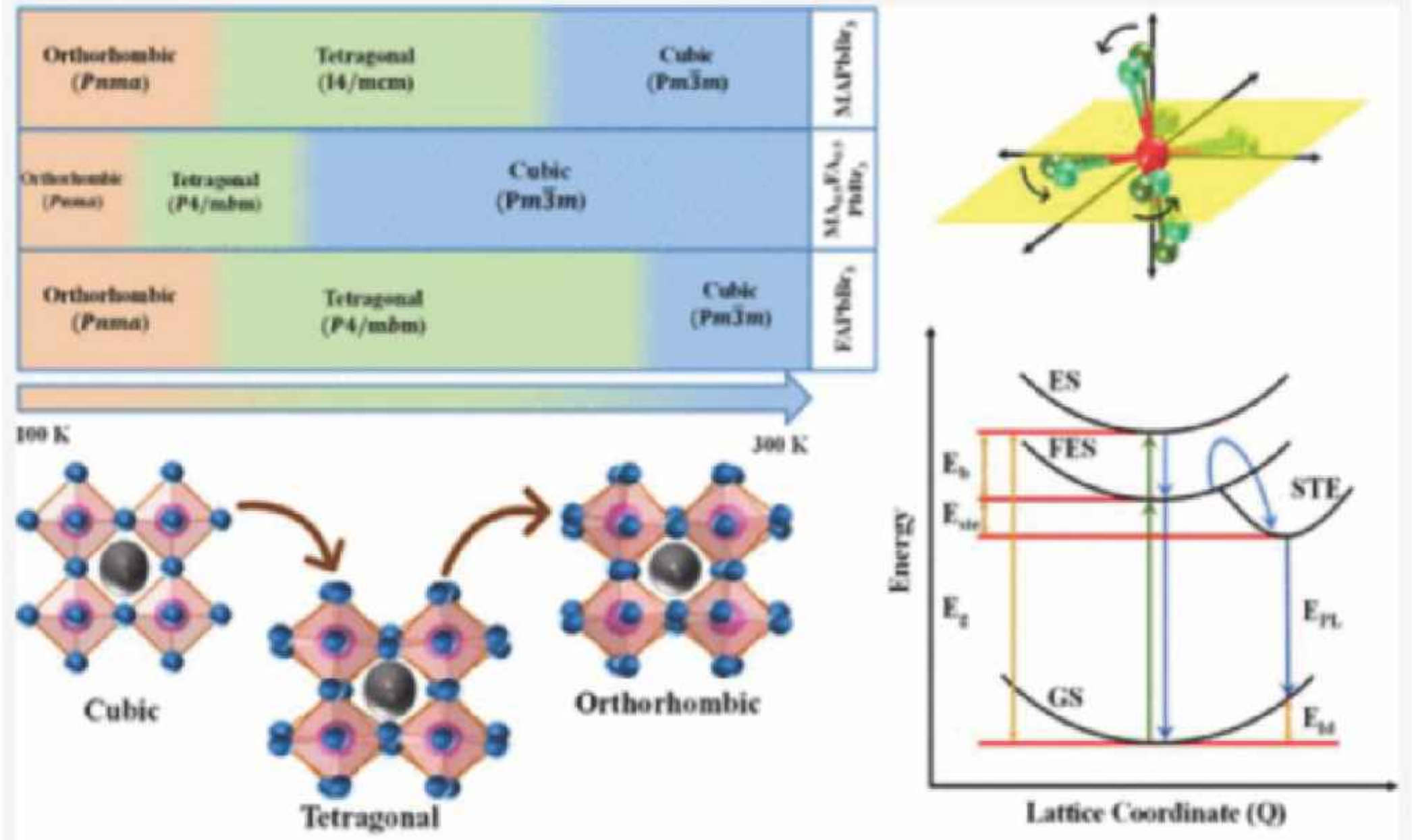
a) Efficient creation of nitrogen-vacancy (NV) centers in diamond

b) Colour centres in diamond for energy applications

2.5.3 Research Contribution by Prof. Dinesh Topwal and his Group Genesis of Broadband Emission in $MA_{1-x}FA_xP_bBr_3$ Perovskites

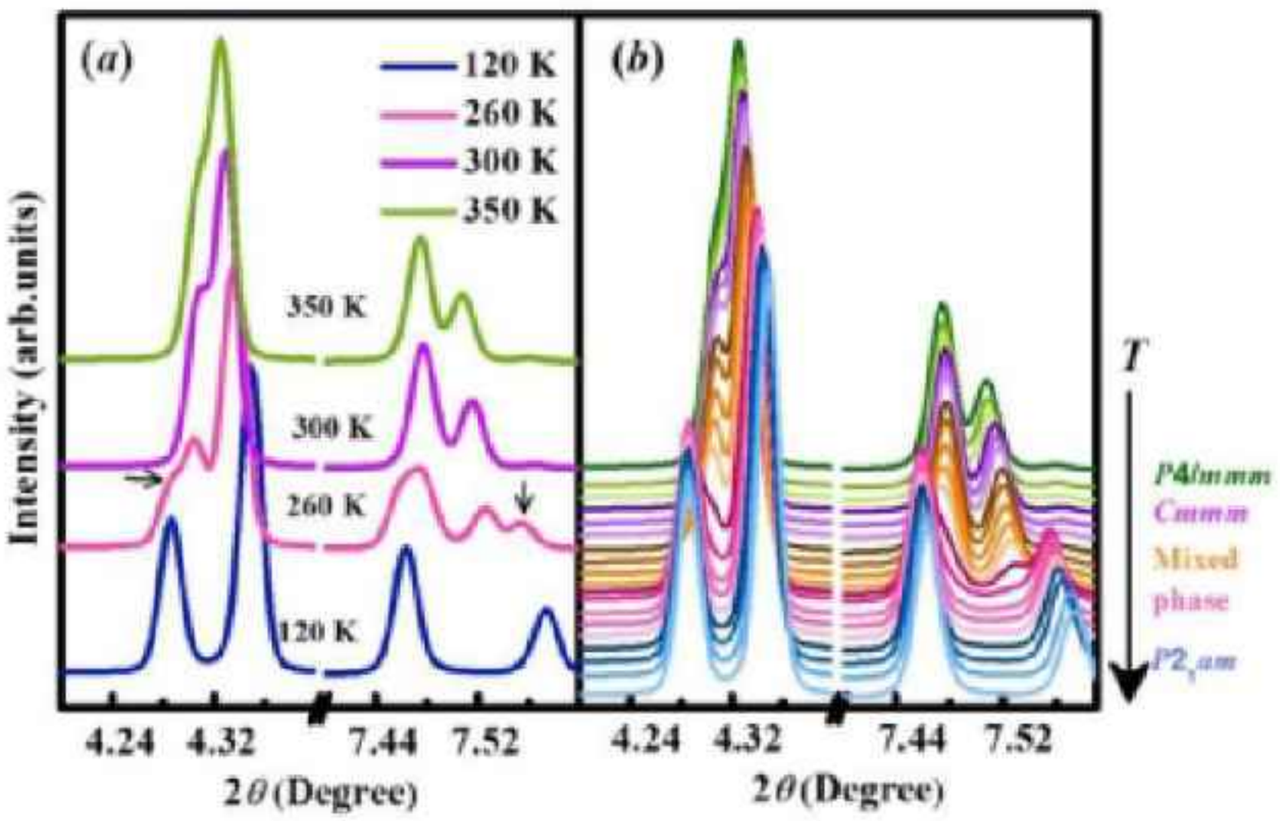
The octahedral distortion plays a pivotal role in influencing various unique electrical and optical properties of organic lead halide perovskites (OLHPs). Unveiling the nature of the response of the local inorganic octahedra to the photophysical properties is a critical step toward understanding the formation of excited-state defects. Here, we report a fundamental understanding of the process of octahedral distortion and its variation with temperature in $MA_{1-x}FA_xPbBr_3$ (x = 0, 0.5, 1) perovskites. Further, the origin of trap states which are

responsible for the broadband emission has been elucidated with the help of detailed structural and photophysical analysis. We find that the intensity and Stoke shift of the broadband emission peaks and charge carrier dynamics are significantly influenced by the changes in Pb–Br bond lengths and Pb–Br–Pb angles. Our findings highlight the relationship between the octahedral distortion and the formation of trap states and provide further insights into tailoring the broadband emission by regulating the local inorganic octahedra in OLHPs.



Intertwined crystal structure, magnetic, and charge transport properties in mixed valent A-site ordered manganite $NdBaMnO_6$

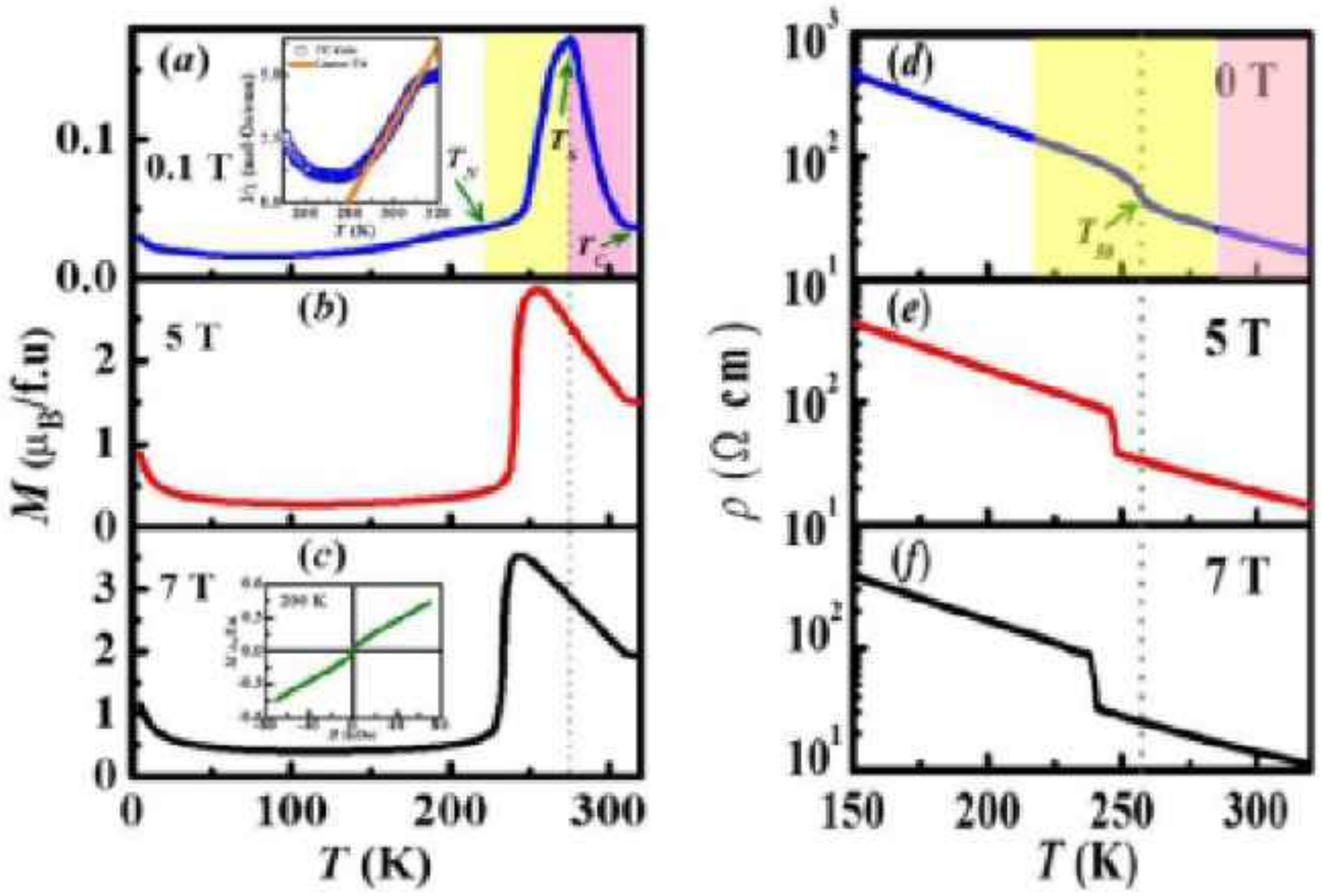
In this work, we reported a correlation between crystal structure, magnetic, and electrical properties in an exotic magnetic compound, $NdBaMn_2O_6$ having ~92% ordering between Nd and Ba, investigated using temperature-dependent synchrotron x-ray diffraction (XRD), dc magnetization and transport measurements. Temperature-dependent XRD data reveals that the compound undergoes various complex crystallographic phase transitions from high-temperature (T > 320 K) P4/mmm phase to intermediate (320 K – 280 K) Cmmm phase to a mixed (Cmmm and P21am) phase



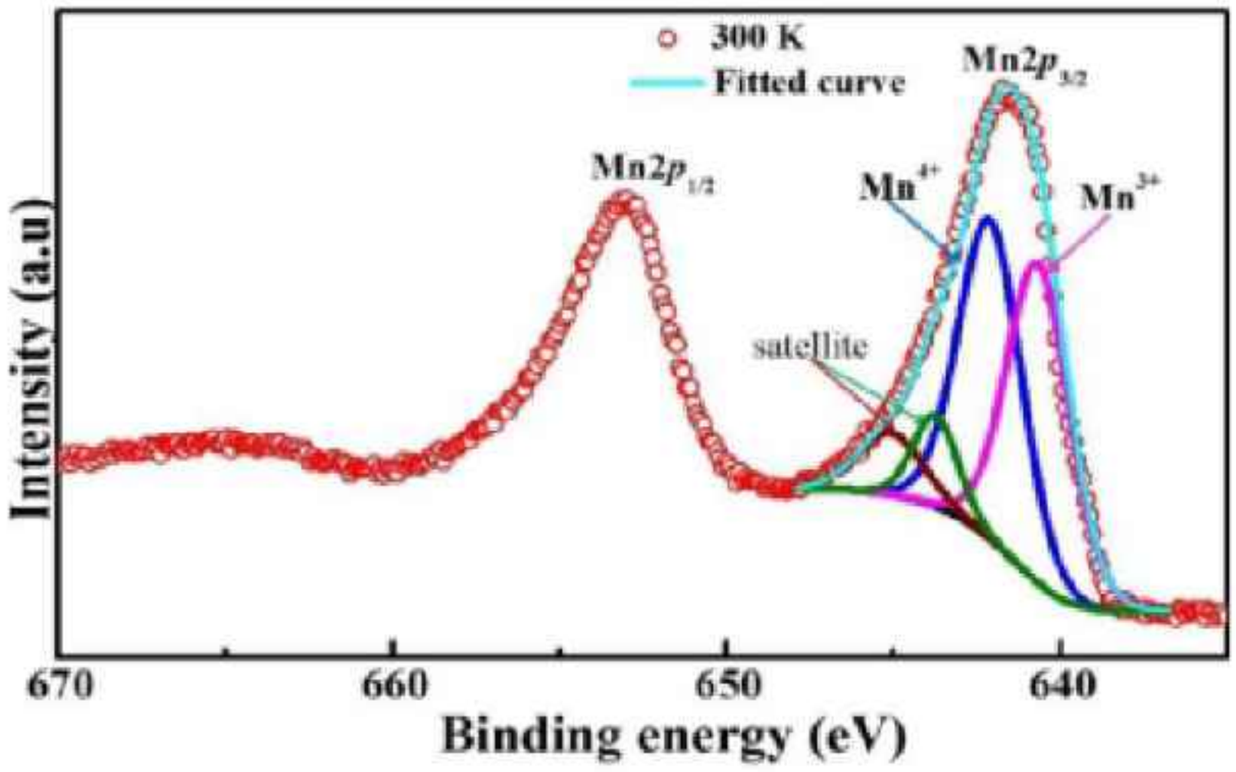
(280 K – 220 K) and to low-temperature P21am phase (T < 220 K). It is found that these crystallographic phase compositions play a crucial role in controlling its magnetic and transport properties. Temperature-dependent dc magnetization data show a sharp drop at the onset of mixed phase (Cmmm + P21am) at 280 K followed by a broad hump at ~ 220 K where mixed phase to P21am transition occurs, thus indicating a correlation between the structural and magnetic properties. The dc magnetization in the mixed phase region is calculated by considering a superposition of the magnetic moments of Cmmm and P21am phases weighted by the fraction of each phase, which exactly follows the experimental magnetization data. Temperature variation of resistivity data shows a jump at ~260 K, a temperature corresponding to 50-50% phase composition of Cmmm and P21am phases. The compound shows insulating behavior over a whole temperature range as confirmed from the resistivity data. Further, application of magnetic field causes a shift of magnetic and transport transition temperatures which may be due to the magnetic field induced structural transition in the system.

Comparison of synchrotron XRD patterns (l = 0.20736 +!) collected at different temperatures during cooling from 350 K for $NdBaMn_2O_6$ in some selected region. Arrows in 260 K data of Fig. (a) shows the new Bragg peaks below 280 K.

Temperature (T) variation of magnetization (M) at different applied magnetic fields: (a) 0.1 T, (b) 5 T and (c) 7 T. Inset of (a) shows the Curie-Weiss fitting above 280 K and inset of (c) shows M-H data at 200 K. Temperature (T) variation of resistivity (r) at different applied field: (d) 0 T, (e) 5 T and (f) 7 T. Both measurements are carried out in field cooled mode. Resistivity is plotted on the log scale for clarity.



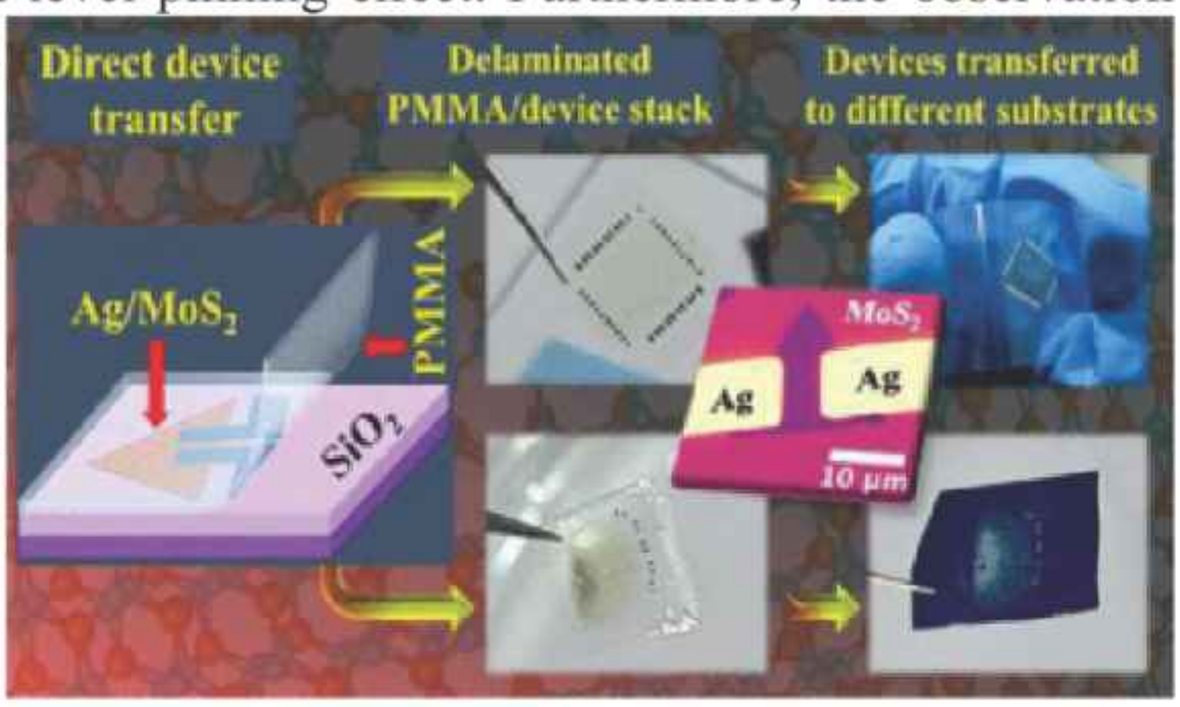
Mn_2p photoemission spectrum (open red circles) of $NdBaMn_2O_6$ at 300 K. Solid lines indicate the fitted results.



2.5.4 Research Contribution by Prof. Satyaprakash Sahoo and his Group

Direct Transfer of Monolayer MoS_2 Device Arrays for Potential Applications in Flexible Electronics:

Transfer techniques of two-dimensional (2D) materials and devices offer nanoscale integration with the existing silicon-based technology and flexible electronics. To date, the chemical etching technique is being widely used for the transfer of 2D materials, and there has been constant effort in improving the method to achieve an etching-free and clean transfer of 2D materials without affecting the device performances. Herein, we demonstrate a poly (methyl methacrylate) (PMMA)-assisted etching-free one-step approach to transfer device arrays consisting of monolayer MoS_2 and metal electrodes to different substrates (i.e., SiO_2/Si, flexible). The crystalline quality, strain relaxation, and interfacial coupling effects of the transferred devices are analyzed using Raman and photoluminescence spectroscopy. The room-temperature gate-tunable drain current measurements of the transferred devices on the SiO_2/Si substrate show a reduced Fermi-level pinning effect. Furthermore, the observation from temperature-dependent threshold voltage shifts, mobilities, and hysteresis evolution indicates an improved transistor performance in the transferred device. The proposed one-step transfer method could be useful to transfer a large array of 2D material devices on arbitrary substrates for future flexible opto-electronic applications.

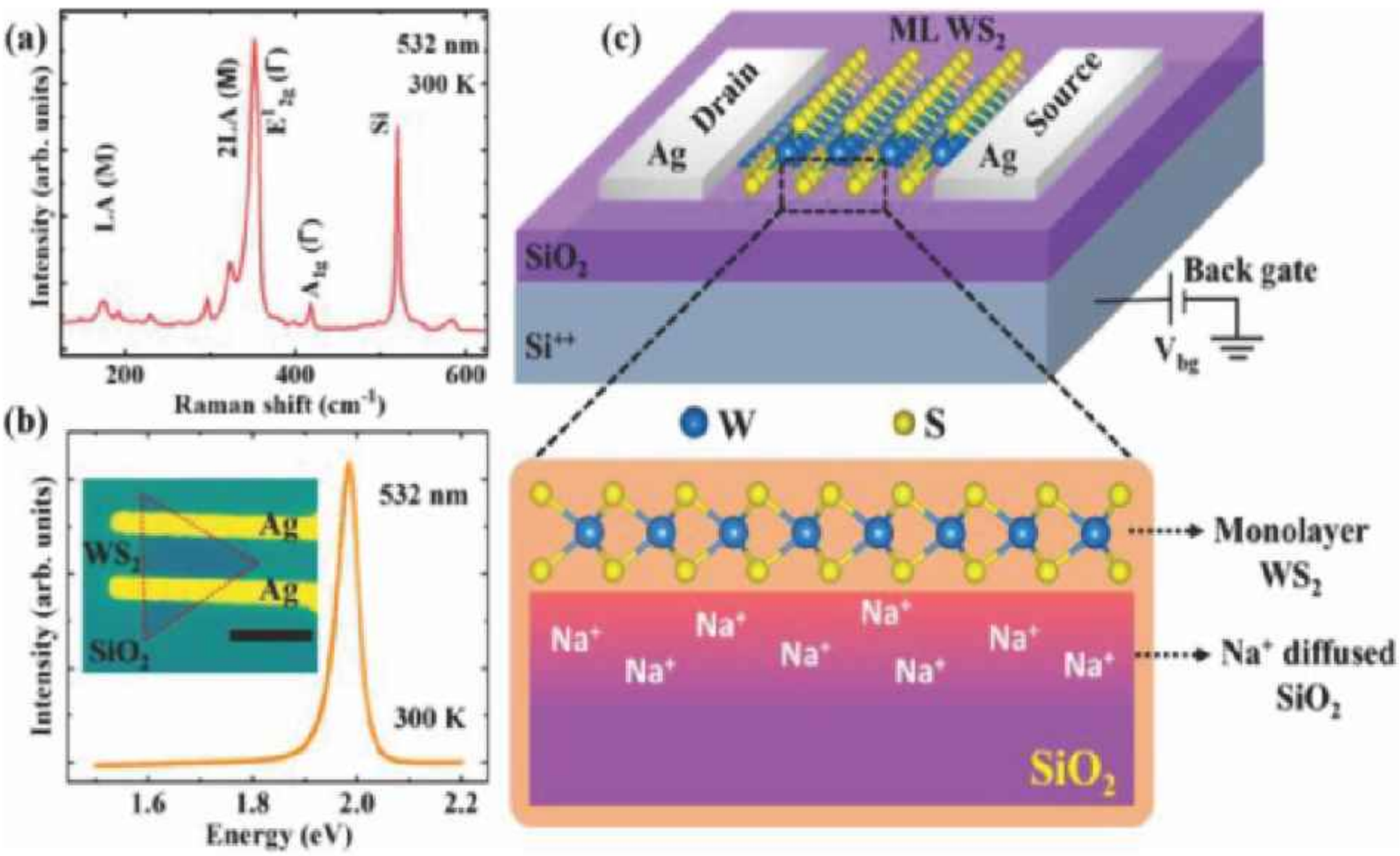


ACS Appl. Nano Mater. 2024, 7, 5, 4796–4804

Ionotronic WS_2 memtransistors for 6-bit storage and neuromorphic adaptation at high temperature:

Inspired by massive parallelism, an increase in internet-of-things devices, robust computation, and Big-data, the upsurge research in building multi-bit mem-transistors is ever-augmenting with different materials, mechanisms, and state-of-the-art architectures. Herein, we demonstrate monolayer WS_2-based functional mem-transistor devices which address nonvolatility and synaptic operations at high temperature. The ionotronic memory devices based on WS_2 exhibit reverse hysteresis with memory windows larger than 25 V, and extinction ratio greater than 106. The mem-transistors show stable retention and endurance greater than 100 sweep cycles and 400 pulse cycles in addition to 6-bit (64 distinct nonvolatile storage levels) pulse-programmable memory features ranging over six orders of current magnitudes. The origin of the multi-bit states is attributed to the carrier dynamics under electrostatic doping

fluctuations induced by mobile ions, which is illustrated by employing a fingerprint mechanism including band-bending pictures. The credibility of all the storage states is confirmed by obtaining reliable signal-to-noise ratios. We also demonstrate key neuromorphic behaviors, such as synaptic plasticity, near linear potentiation, and depression, rendering it suitable for successful implementation in high temperature neuromorphic computing. Furthermore, artificial neural network simulations based on the conductance weight update characteristics of the proposed ionotronic mem-transistors are performed to explore the potency for accurate image recognition. Our findings showcase a different class of thermally aided memories based on 2D semiconductors unlocking promising avenues for high temperature memory applications in demanding electronics and forthcoming neuro morphic computing technologies. We have demonstrated similar operations in MoS_2 based devices.

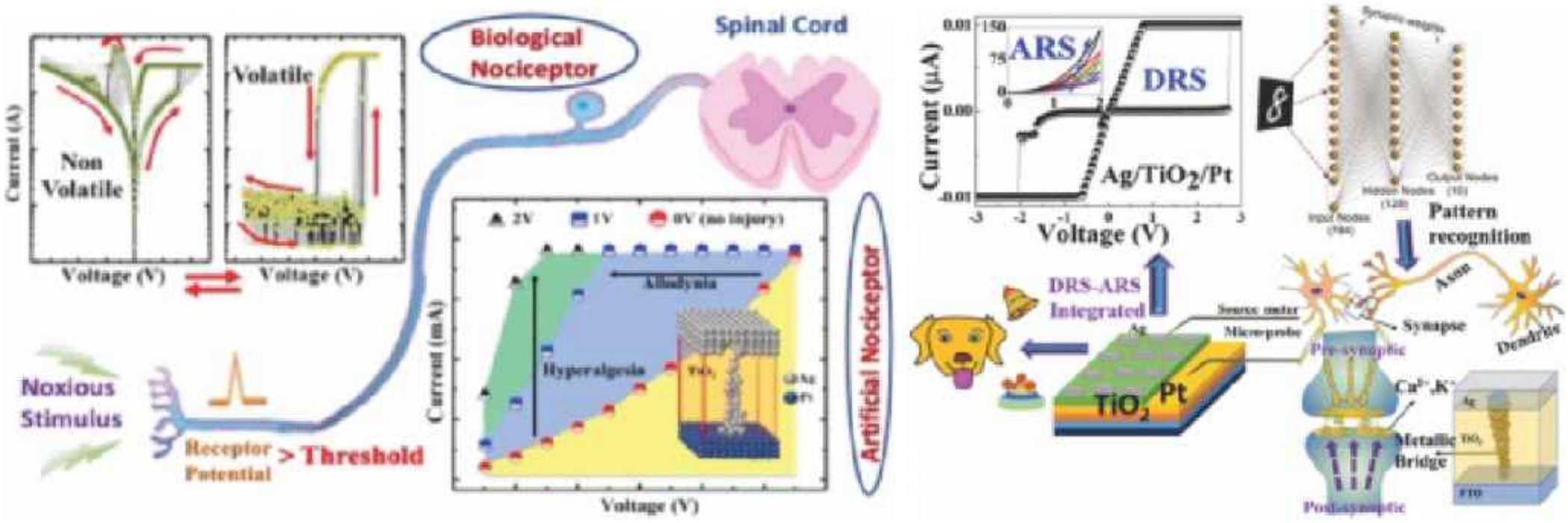


npj 2D Mater Appl 7, 63 (2023), ACS Appl. Mater. Interfaces 2023, 15, 30, 36527–36538

Reconfigurable Low-Power TiO_2 Memristor for Integration of Artificial Synapse and Nociceptor: Bio-mimetic advanced electronic systems

These are emerging rapidly, engrossing their applications in neuromorphic computing, humanoid robotics, tactile sensors, and so forth. The biological synaptic and nociceptive functions are governed by intricate neurotransmitter dynamics that involve both short-term and long-term plasticity. To emulate the neuronal dynamics in an electronic device, an $Ag/TiO_2/Pt/SiO_2/Si$ memristor is fabricated, exhibiting compliance current controlled reversible transition of volatile switching (VS) and non-volatile switching (NVS). The origin of the VS and NVS depends on the diameter of the conducting filament, which is explained using a

field-induced nucleation theory and validated by temporal current response measurements. The switching delay of the device is used to determine the characteristic nociceptive behaviors such as threshold, relaxation, inadaptation, allodynia, and hyperalgesia. The short-term and long-term retention loss attributed to the VS and NVS, respectively, is used to emulate short-term memory and long-term memory of the biological brain in a single device. More importantly, synergistically modulating the VS–NVS transition, the complex spike rate-dependent (SRDP) and spike time-dependent plasticity (STDP) with a weight change of up to 600% is demonstrated in the same device, which is the highest reported so far for TiO_2 memristors. Furthermore, the device exhibits very low power consumption, <"3.76 pJ/spike, and can imitate synaptic and nociceptive functions. The consolidation of complex nociceptive and synaptic behavior in a single memristor facilitates low-power integration of scalable intelligent sensors and neuromorphic devices.



ACS Appl. Mater. Interfaces 2023, 15, 21, 25713–25725, ACS Appl. Mater. Interfaces 2023, 15, 2, 3574–3585

2.5.5 Research Contribution by Prof. Debakanta Samal and his Group

Emergent quantum transport due to quenched magnetic impurity scattering by antiferromagnetic proximity in $SrCuO_2/SrIrO_3$

– Gaining control over electron scattering in complex materials is a critical step to advance the understanding that can have technological implication. Through an antiferromagnetic proximity effect, we observe an enhanced effective phase coherence length (li") in a spin-orbit coupled semimetal $SrIrO_3$ (which is predicted to host 3D Dirac quasiparticles near the Fermi energy) from quantum interference originated magnetoconductance study. The above effect is discussed in view of quenching of magnetic impurity scattering which originates from spin Andreev reflection at antiferromagnet ($SrCuO_2$)/$SrIrO_3$ interface. More importantly, we observe chiral anomaly induced topological electron transport in longitudinal magnetoconductance (B E) for the $SrCuO_2/SrIrO_3$ bilayer which is absent in bare $SrIrO_3$ film. Compared to the results on bare $SrIrO_3$ film,

antiferromagnetic proximity effect in $SrCuO_2/SrIrO_3$ unfolds a practical means to circumvent the detrimental effect of unintended magnetic impurity scattering and preserve topological electron transport in $SrIrO_3$. [Reference: Phys. Rev. B 107, 134415 (2023)]

Crystal structure and magnetic properties of the spin-1/2 frustrated two-leg ladder compounds (C4H14N2)Cu25ØKÜ6 (5ØKÜ=Cl and Br)

This work involves the successful synthesis of single crystals, and investigation of the magnetic properties of a new family of copper halides $(C4H14N_2)Cu2X_6$ (X = Cl, Br). These compounds crystallize in an orthorhombic crystal structure with space group Pnma. The crystal structure features Cu^{2+} dimers arranged parallel to each other that makes a zigzag two-leg ladder like structure. Further, there exists a diagonal interaction between two adjacent dimers which generates interdimer frustration. Both the compounds manifest a singlet ground state with a large gap in the excitation spectrum. Magnetic susceptibility is analyzed in terms of both interacting spin-1/2 dimer and two-leg ladder models followed by exact diagonalization calculations. Our theoretical calculations in conjunction with the experimental magnetic susceptibility establish that the spin lattice can be described well by a frustrated two-leg ladder model with strong rung coupling [J0/kB = 116.0(2) and 300.0(2) K], weak leg coupling [J/kB = 18.6(2) and 105.0(2) K], and equally weak diagonal coupling [J/kB = 23.2(2) and 90.0(2) K] for Cl and Br compounds, respectively. These exchange couplings set the critical fields very high, making them experimentally inaccessible. The correlation function decays exponentially as expected for a gapped spin system. The structural aspects of both the compounds are correlated with their magnetic properties. The calculation of entanglement witness divulges strong entanglement in both the compounds which persists up to high temperatures, even beyond 370 K for the Br compound.

2.6 Theoretical Condensed Matter Physics (G. Tripathy, S. Mandal, A. Saha and D. Chaudhuri)

At IOP, the condensed matter theory group is involved in cutting-edge research in various aspects of quantum condensed matter physics and studies of complex systems, including statistical physics, active matter physics, and the physics of life.

Quantum Condensed Matter Physics

In this field, the activity of the group involves the exploration of emergent electronic and magnetic properties of various quantum materials. This includes a special emphasis on studies of high-temperature superconductors, iron-pnictides, frustrated magnetism, topological insulators, dynamical construction of higher-order topological superconductors, Floquet Majorana modes in Rashba nanowires, and topological superconductivity in magnetic spin chains.

Complex systems

In complex systems research, the main current emphasis is on the development of understanding in various aspects of the physics of life and active matter. Studies were performed proposing and exploring a simple model of ant-trail formation, the dynamics of cytoskeletal filaments driven by molecular motors and related active polymers, exact calculation of transport properties of dynamical or shape anisotropic active Brownian particles, studies of stop-and-go motion in animals and bacteria, exploring properties of scalar active baths, and the impact of reciprocity and its absence on active nematics.

2.6.1 Research Contribution by Prof. Saptarshi Mandall and his Group

Projective symmetry group classification of Abrikosov fermion mean-field ansätze on the square-octagon lattice

We have investigated PSG anaysis for square-octagon lattice and the result obtained contains Employing the Abrikosov fermion representation for spin 12, we obtain 32SU(2), 1808U(1), and 384 Z2 algebraic PSGs. This yields a complete spin-liquid state possible in this lattice. Results are published in Atanu Maity, Francesco Ferrari, Ronny Thomale, Saptarshi Mandal, and Yasir Iqbal [Phys. Rev. B 107, 134438 , (2023).]

Multiple higher-order topological phases with even and odd pairs of zero-energy corner modes in a C3symmetry broken model

Further we have extended our study of topological characterization of extended Haldane model to anistropic limite and found various HOTI phases with miltiple zero energy mid gap states even in the absence of inversion symmetry. The rsults are published in Sudarshan Saha, Tanay Nag and Saptarshi Mandal, Europhysics Letters, Volume 142, Number 5 Citation Sudarshan Saha et al 2023 EPL 142 56002.

2.6.2 Research Contribution by Prof. Arijit Saha and his Group

Topological Superconductivity in Magnet/Superconductor Heterostructures

A strong quest for topological superconductors (TSCs) hosting Majorana zero-modes (MZMs) has been accumulating an immense interest based on magnetic adatoms fabricated on top of an s-wave superconductor (SC) substrate. In our first work in this direction, we report on a realistic and rather general scheme where noncollinear magnetic textures proximitized with the most common s-wave superconductor can appear as the alternative to p-wave superconductor—the prime proposal to realize two-dimensional (2D) Kitaev model for topological superconductors (TSCs) hosting Majorana flat edge mode (MFEM). A general minimal Hamiltonian suitable for magnet/superconductor heterostructures reveals robust MFEM within the gap of Shiba bands due to the emergence of an effective "px + py"-type p-wave pairing, spatially localized at the edges of a 2D magnetic domain of spin spiral. We finally verify this concept by considering Mn (Cr) monolayer grown on an s-wave superconducting

substrate Nb(110) under strain [Nb(001)]. In both 2D cases, the antiferromagnetic spin-spiral solutions exhibit robust MFEM at certain domain edges that is beyond the scope of the trivial extension of one-dimensional (1D) spin-chain model in 2D. This approach, particularly when the MFEM appears in the TSC phase for such heterostructure materials, offers a perspective to extend the realm of the TSC in 2D. In our second work, we put forth a theoretical framework for engineering a 2D second-order topological superconductor (SOTSC) by utilizing a heterostructure: incorporating noncollinear magnetic textures between an s-wave superconductor and a 2D quantum spin Hall insulator. It stabilizes the higher order topological superconducting phase, resulting in Majorana corner modes (MCMs) at four corners of a 2D domain. The calculated nonzero quadrupole moment characterizes the bulk topology. Subsequently, through a unitary trans- formation, an effective low-energy Hamiltonian reveals the effects of magnetic textures, resulting in an effective in-plane Zeeman field and spin-orbit coupling. This approach provides a qualitative depiction of the topological phase, substantiated by numerical validation within an exact real-space model. Analytically calculated effective pairings in the bulk illuminate the microscopic behavior of the SOTSC. The comprehension of MCM emergence is supported by a low-energy edge theory, which is attributed to the interplay between effective pairings of ($p_x + p_y$)-type and ($p_x + ip_y$)-type. Our extensive study paves the way for practically attaining the SOTSC phase by integrating noncollinear magnetic textures.

Floquet Majorana modes in helical Shiba chain

Non-equilibrium aspects of topological phases have attracted a great deal of attention in the community as the driven topological systems exhibit non-trivial properties which are absent in the corresponding static phase. In this direction, we theoretically explore the Floquet generation of Majorana end modes (MEMs; both regular 0 modes and anomalous ð modes) implementing a periodic sinusoidal modulation in the chemical potential in an experimentally feasible setup based on a one-dimensional chain of magnetic impurity atoms having spin spiral configuration (out-of-plane Neìel type) fabricated on the surface of a common bulk s-wave superconductor. We obtain a rich phase diagram in the parameter space, highlighting the possibility of generating multiple 0- and ð-MEMs localized at the end of the chain. We also study the real-time evolution of these emergent MEMs, especially when they start to appear in the time domain. These MEMs are topologically characterized by employing the dynamical winding number. We also discuss the possible experimental parameters in connection to our model. Our work paves the way to realize Floquet MEMs in a magnet-superconductor heterostructure.

2.6.3 Research Contribution by Prof. Debasish Chaudhuri and his Group

Our research focuses on the Physics of Life and Active Matter, utilizing non-equilibrium statistical physics, soft matter physics, and stochastic processes. This past year, we studied

phase transitions in active nematics, inertial effects on active matter, properties of chiral active matter, the dynamics of active harmonic baths, and the impact of active stop-and-go motion on survival at different scales from bacteria to animals. Additionally, we analyzed live C. elegans experiments by a biology group at TIFR-Mumbai, using our analytical theory to uncover cooperative cargo binding by molecular motors transporting neuronal cargo. During the year, I supervised the work of five Ph.D. scholars (Arpan Sinha, Chitrak Karan, Manish Patel, Subhrangshu Sekhar Mishra, and Raj Upadhyay) and one Post-doctoral researcher (Dr. Rajneesh Kumar). Further details of our research are outlined below:

a. **Non-reciprocity in Active nematics:** The impact of reciprocity in emergent properties of active nematics is studied through three microscopic models with shared symmetry. These models reveal that the presence or absence of reciprocity dictates whether the ordering transition is continuous or first order despite all exhibiting fluctuation-dominated phase separation and quasi-long-range order in the nematic phase.

b. **Free inertial ABPs:** The study investigates free inertial Active Brownian Particles (ABP) in the presence of thermal noise, utilizing a Laplace transform method to derive the exact temporal evolution of dynamical moments. Results demonstrate that inertia significantly affects steady-state kinetic temperature and swim pressure, with a re-entrant transition in velocity distribution, and construct a phase diagram based on the d-dimensional kurtosis, offering insights into time-dependent crossovers observed in various moments.

c. **Trapped inertial ABPs:** The study examines inertial ABP in a d-dimensional harmonic trap with translational diffusion, leveraging a Laplace transform method to compute the time evolution of all dynamical moments precisely. Results reveal that both inertia and trap strength influence the effective diffusivity and steady-state kinetic temperature, unlike passive systems, and detailed phase diagrams based on velocity and position kurtosis illustrate potential re-entrance phenomena.

d. **Inertial scalar active Bath:** Active baths exhibit non-Gaussian velocity distributions and a quadratic dependence on active velocity for kinetic temperature and diffusion coefficient, valid in over-damped systems. At the same time, inertial effects induce normal velocity distributions with kinetic temperature and diffusion coefficient scaling. Additionally, late-time diffusivity and mobility decrease with mass, and equilibrium-like behavior is restored by inertial mass, asymptotically recovering the equilibrium Einstein relation.

e. **Inertial active polymer:** The study investigates a two-dimensional, tangentially active, semi-flexible, self-avoiding polymer, revealing a dynamic re-entrant transition from motile open chains to spinning achiral spirals as activity increases. A detailed phase diagram is constructed in the activity-inertia plane, showing how inertial effects

destabilize spirals at higher activity levels, leading to alterations in size, shape, and persistence of spinning.

f. **Chiral active matter:** This work explores the influence of chirality and translational diffusion on active Brownian particles in two and three dimensions, utilizing a Laplace transform method to compute dynamic moments' temporal evolution precisely. The analysis provides explicit expressions for, e.g., second and fourth moments of displacement, showcasing oscillatory behavior and deviations from Gaussian distribution, highlighting the impact of persistence and chirality.

g. **Active harmonic bath:** The study investigates a tracer's dynamics in an active particle harmonic chain, considering interactions' influence through mean-squared displacements (MSD) and space-time correlations analyzed via Green's function techniques and numerical simulations. Depending on chain characteristics, tagged-particle MSD displays ballistic, diffusive, and single-file diffusion (SFD) scaling, with transitions in bulk particle displacement distributions from bimodal to Gaussian, alongside expressions for steady-state static and dynamic two-point displacement correlations, consistent with simulations.

h. **Active stop and go motion:** The study examines active Brownian particles exhibiting intermittent dynamics between run and stop states, prevalent across various scales from bacteria to artificial systems. It offers exact solutions for transport properties like velocity autocorrelations and diffusion coefficients. Particle spread hinges on subtle factors, such as the retention of active orientation memory during stop events, with predicted dynamic strategies to maximize effective diffusivity, potentially enhancing access to distributed resources for active agents.

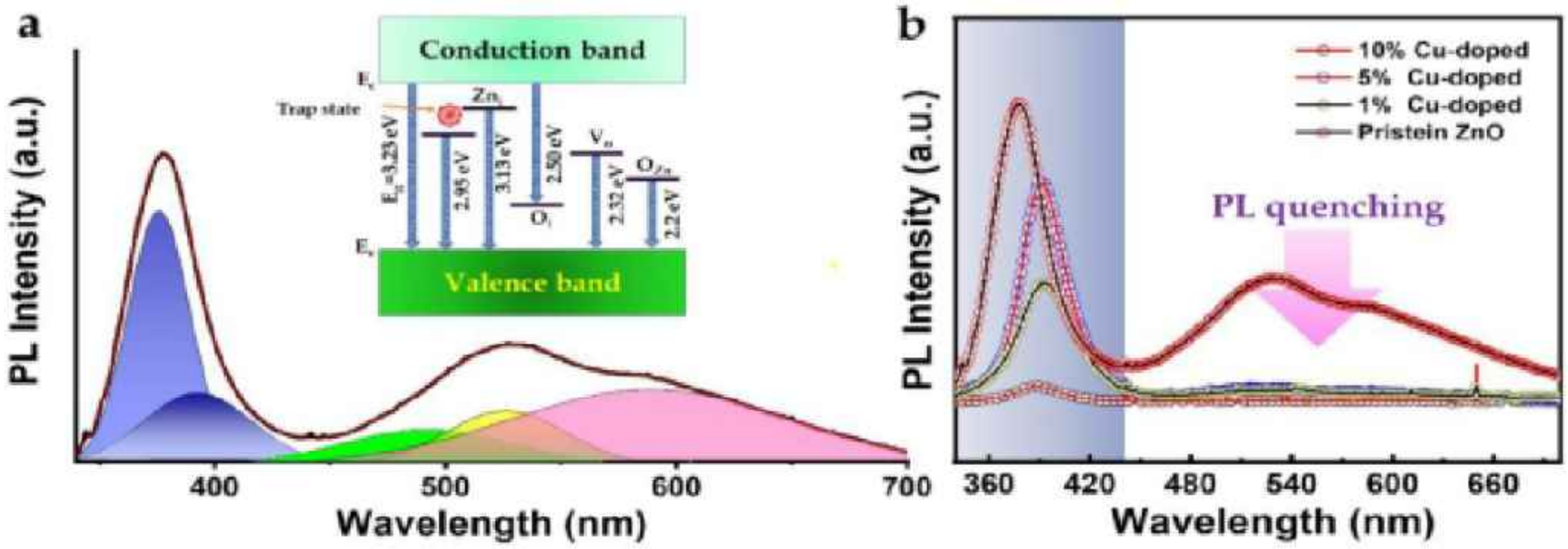
Neuronal cargo transport in C. elegans:

Axonal transport in neurons relies on kinesin-3 motors like UNC-104, anterogradely transporting synaptic vesicle precursors. Knockdown of fbxb-65 leads to UNC-104 accumulation at neuronal distal ends, altering its movement and cargo levels, suggesting FBXB-65's role in regulating post-translational modifications and motor-cargo interaction for precise synaptic delivery. The analytic theory that we developed led to the discovery of a cooperative cargo binding by the motor proteins.

2.7 Research work carried out by Other Groups

A facile electrochemical synthesis of crystalline (100) oriented Zinc oxide (ZnO) nanowires on indium tin oxide films is presented. The effect of copper doping in modifying the morphology, structure, photoluminescence and band-gap of ZnO nanorods has also been investigated. Remarkably during the process of Cu doping, although the nanorods retain their crystalline

orientation, a lattice expansion, defect generation as well as morphological modifications are observed using X-ray diffraction, Raman spectroscopy and Scanning electron microscopy. Results also confirm a band-gap tuning of the as-synthesized nanorods as well as after Cu doping. A red shift in the band-gap from 3.23, for pristine ZnO nanorods, to 2.37 eV after 10% Cu incorporation is noticed. Significantly, PL results indicate that although the pristine ZnO nanorods are in photoluminescence ON state with highest PL intensity, a PL OFF state (with 98% visible PL quenched) is present after 1% Cu incorporation.



(**a**) Deconvolution of Photoluminescence spectrum of pristine ZnO nanorod. Inset represents various nearby energy band edges calculated from respective emissions of ZnO, (**b**) shows PL of pristine and after Cu doping

2.7.1 Room temperature synthesis of structure–morphology tuned copper-doped ZnO nanorods and their photo-physics.

S. N. Sarangi, R. K. Sahoo, A. K. Manna, P. Dash, S. K. Choudhury, S. Varma

2.7.2 Pulsar as a Weber detector of gravitational waves and a probe to its internal phase transitions

Ajit M. Srivastava, Partha Bagchi, Oindrila Ganguly, Biswanath Layek, Anjishnu Sarkar

Any pulsar deformation leaves imprints on the pulses by affecting its moment of inertia tensor. We show that with this one can explore various phase transitions inside a pulsar core by induced density fluctuations. We also show that this allows the neutron star to perform as a Weber detector of Gws.

2.7.3 Percolating cosmic string loops from evaporating primordial black holes

Pulsar timing data from NANOGrav Collaboration has regenerated interest in the possibility of observing stochastic gravitational wave background from cosmic strings. We propose a new model where a network of high energy scale cosmic strings can form even at low temperatures due to local heating and subsequent cooling of plasma by evaporating primordial black holes (PBHs).

2.7.4 Detecting superfluid transition in the pulsar core,

We consider vortex network formation in a superfluid transition inside a pulsar via the Kibble-Zurek mechanism. The non-zero angular momentum resulting from this vortex network affects the pulse timing and pulse profile of a pulsar, with the changes decaying away with specific scaling laws, which can be detected using high precision pulsar observations.

Ajit M. Srivastava, Partha Bagchi, Biswanath Layek, Dheeraj Saini, Anjishnu Sarkar, Deepthi G. Venkata,

2.7.5 Observing collision of asteroid with neutron stars by modifications of pulsar signal

We use our earlier technique of detecting changes in the moment of inertia of a pulsar by pulse observations, to the case of asteroid collision with a neutron star. Such collisions have been proposed as explanation of gamma ray bursts. We propose to look for pulse modifications in correlation with such gamma ray bursts.

Ajit M. Srivastava, Partha Bagchi, Biswanath Layek, Anjishnu Sarkar

2.7.6 Hawking radiation from acoustic black holes and dynamical horizon in ultra-relativistic heavy ion collisions

We discuss Hawking radiation from acoustic black holes in ultra-relativistic heavy-ion collisions, where boost-invariant longitudinal flow of QGP leads to dynamical event horizon, moving away from center with sound velocity. This leads to infinite red shift of Hawking radiation. We show that due to QGP flow at very large rapidities deviating from boost invariant flow, an observer close to that region sees event horizon with a finite redshift, leading to observable effects for a window of rapidities.

Ajit M. Srivastava and Sanatan Digal

2.7.7 Calculation of effects of Hawking radiation from acoustic black holes in relativistic heavy- ion collisions on PT distribution of hadrons"

We are calculating the effects of thermal Hawking radiation from acoustic black holes in relativistic heavy-ion collisions in terms of a thermal component in the rapidity dependence of the transverse momentum distribution of detected particles.

Ajit M. Srivastava, Oindrila Ganguly and Sanatan Digal

2.7.8 Current-current correlations as signature of correlated Hawking pair in hydrodynamical flow of electrons

In an earlier work, we predicted that acoustic black holes can form in the hydrodynamic flow of electrons resulting in Hawking radiation of phonons which should be observable in

terms of current fluctuations. We are calculating resulting current-current correlations on the two sides of the sonic horizon as expected from the correlated Hawking particle pairs.

Ajit M. Srivastava and Sanatan Digal

2.7.9 Liquid crystal experiments with nanorods and nanodots for detecting their shapes by brush geometries

In our earlier work, using numerical simulations, we have proposed to detect shapes of microbes embedded in a liquid crystal sample by observing geometry of resulting dark brushes with optical microscopy using a cross-polarizer set up. We are working on checking these predictions with the use of nanorods and nanodots (representing cylindrical and spherical shapes of bacteria and viruses), in the liquid crystal lab.

Ajit M. Srivastava

Chapter 3

PUBLICATIONS

3.1. Papers Published in Refereed Journal

Condensed Matter Physics (Experiment)

1. High entropy alloying strategy for accomplishing quintuple-nanoparticles grafted carbon towards exceptional high-performance overall seawater splitting.
   G. Raj, R. Nandan, K. Kumar, D. B. Gorle, A. B. Mallya, S. M. Osman, J. Na*, Y. Yamauchi, and K. K. Nanda, Materials Horizons 10, 5032-5044 (2023).

2. Dual-Polarity Switching in Self-Powered Ag/MoS$_2$/Ag Photodetectors.
   P. Augustine, D. K. Singh, K. L. Kumawat, V. Sivan, S. B. Krupanidhi, and K. K. Nanda, ACS Applied Optical Materials 1, 1396-1404 (2023).

3. Photocurrent Polarity Switching and Enhanced Photoresponse in Silver Nanoparticles Decorated a-GaN-Based Photodetector.
   D. K. Singh, P. Prajapat, J. Saroha, R. K. Pant, S. N. Sharma, K. K. Nanda, S. B. Krupanidhi, and G. Gupta, ACS Applied Electronic Materials 5, 1394-1400 (2023).

4. Solid-state synthesis of Pt/C cathode catalysts for direct methanol fuel cells.
   B. Roul, D. B. Gorle, G. Raj, K. Kumar, M. Kumari, K. K. Nanda, and S. B. Krupanidhi, Journal of Materials Chemistry C 11, 11072-11081 (2003).

5. Intrinsic stability of perovskite materials and their operational stability in light-emitting diodes.
   K. L. Kumawat, K. K. Nanda, and P. Rajamalli, Journal of Materials Chemistry C 11, 7159-7182 (2003).

6. Reduced-Graphene Oxide Decorated ã-In$_2$Se$_3$/Si Heterostructure Based Broadband Photodetectors with Enhanced Figures-of-Merit.
   B. Roul, A. M. Chowdhury, M. Kumari, K. L. Kumawat, S. Das, K. K. Nanda, and S. B. Krupanidhi, Materials Advances 4, 596-606 (2023).

7. Room Temperature Synthesis of Structure - Morphology Tuned Copper Doped ZnO Nanorods and their Photo-physics.
   S.N. Sarangi, R. K. Sahoo, Ashis K. Manna, P. Dash, S. K. Choudhury and Shikha Varma, Journal of Materials Science: Materials in Electronics 34, 22 (2023).

8. Synergetic effect of Sb ion implantation on the optical and structural properties of single crystal rutile TiO2 (110).
   Shalik R. Joshi and Shikha Varma, Current Applied Physics 56, 85 (2023).

9. Non-enzymatic glucose sensors based on electrodeposited CuxO–ZnO composite nanostructures.
   AK Manna, P Guha, SK Srivastava, S Varma, Journal of Materials Science: Materials in Electronics 35, 1-12 (2024).

10. Graded oxide layer for high-performing nanosized synaptic emulator.
    Sudheer, R. Mandal, V. Pachchigar, K. P. Sooraj, B. Satpati, T. Som, M. Ranjan, Applied Surface Science, 2023/8/6, 158115.

11. Investigation of Defect-Driven Memristive and Artificial Synaptic Behaviour at Nanoscale for Potential

Application in Neuromorphic Computing.
R. Mandal, D. Hasina, A. Mandal, T. Som,
Proc. Natl. Acad. Sci., India, Sect. A Phys. Sci. 93, 445-450 (2023).

12. Site-Specific Emulation of Neuronal Synaptic Behavior in Au Nanoparticle-Decorated Self-Organized TiO_2 Surface.
D. Hasina, M. Saini, Mohit Kumar, A. Mandal, N. Basu, P. Maiti, S.K. Srivastava, T. Som, Small 20, 2305605 (2024).

13. Towards on-receptor computing: Electronic nociceptor embedded neuromorphic functionalities at nanoscale.
R. Mandal, A. Mandal, T. Som, Applied Materials Today 37, 102103 (2024).

14. Direct Transfer of Monolayer MoS_2 Device Arrays for Potential Applications in Flexible Electronics.
S. K. Mallik, R. Padhan, S. Roy, M. C. Sahu, S. Sahoo, ACS Applied Nano Materials 7, 4796–4804 (2024).

15. Ionotronic WS_2 memtransistors for 6-bit storage and neuromorphic adaptation at high temperature.
S. K. Mallik, R. Padhan, M. C. Sahu, G. K. Pradhan, P. K. Sahoo, S. P. Dash, S. Sahoo,
NPJ 2D Materials and Applications 7, 63 (2023).

16. Thermally Driven Multilevel non-Volatile Memory with Monolayer MoS_2 for Brain-Inspired Artificial Learning.
S. K. Mallik, R. Padhan, M. C. Sahu, S. Roy, G. K. Pradhan, P. K. Sahoo, S. P. Dash, S. Sahoo, ACS Applied Materials & Interfaces 15, 30, 36527–36538 (2023).

17. Reconfigurable Low Power TiO_2 Memristor for Integration of Artificial Synapse and Nociceptor.
M. C. Sahu, A. K. Jena, S. K. Mallik, S. Roy, S. Sahoo, R. S. Ajimsha, P. Misra, and S. Sahoo, ACS Applied Materials & Interfaces 15, 21, 25713–25725 (2023).

18. High Responsivity in Monolayer MoS_2 Photodetector via Controlled Interfacial Carrier Trapping.
S. Sahoo, M. C. Sahu, S. K. Mallik, A. K. Jena, G. K. Pradhan, and S. Sahoo, ACS Appl. Electron. Mater 5, 1077–1087 (2023).

19. Bipolar resistive switching in TiO_2 artificial synapse mimicking the Pavlov's associative learning.
A. K. Jena, M. C. Sahu, K. U. Mohanan, S. K. Mallik, S. Sahoo, G. K. Pradhan, S. Sahoo, ACS Applied Materials & Interfaces 15, 3574–3585 (2023).

20. Multifunctional 2D MoS2 optoelectronic artificial synapse with integrated arithmetic and reconfigurable logic operations for in-memory neuromorphic computing applications.
M. C. Sahu, S. Sahoo, S. K. Mallik, A. K. Jena, S. Sahoo, Advanced Materials Technology, 202201125 (2023).

21. Intertwined crystal structure, magnetic, and charge transport

properties in mixed valent A-site ordered manganite $NdBaMn_2O_6$
A. Khatun, P. Aich, A. Schoekel, A. Gloskovskii, S. Panda, N. Patra, Subhendra, D. Mahanti, U. Manju, D. Topwal, Journal of Alloys and Compounds 988, 174205 (2024).

22. Dynamic Structural Evolution and Dual Emission Behavior in Hybrid Organic Lead Bromide Perovskites.
D. Kalita, P. Nandi, P. Sahu, A. Schoekel, J. van Embden, D. Topwal, U. Manju, The Journal of Physical Chemistry Letters 15, 2557-2565 (2024).

23. Elucidating Phase Transitions and the Genesis of Broadband Emission in $MA_{1-x}FA_xPbBr_3$ Perovskites.
D. Kalita, P. Sahu, P. Nandi, K. K. Madapu, S. Dhara, A. Schoekel, Subhendra. D. Mahanti, D. Topwal, U. Manju, The Journal of Physical Chemistry C 127 (51), 24608-24617 (2023).

24. Tuning of magnetic frustration and emergence of a magnetostructural transition in $Mn_{1-x}CdxCr_2O_4$
A. Das, D. Ranaut, P. Pal, R. Pal, S. Moulick, M. Das, D. Topwal, P. Mandal, A. N. Pal, K. Mukherjee, and D. Choudhury, Phys. Rev. B 108(6), 064426 064426 (2023).

25. Evidence of weak itinerant ferromagnetism and Griffiths like phase in MnFeGe.
H. K. Dara, D. Patra, G. P. Moharana, S. N. Sarangi and D. Samal, J. Phys.: Condens. Matter 35, 395802 (2023).

26. Crystal structure and magnetic properties of the spin-12 frustrated two-leg ladder compounds $(C_4H_{14}N_2)Cu_2X_6$ (X=Cl and Br).
P. Biswal, S. Guchhait, S. Ghosh, S. N. Sarangi, D. Samal, D. Swain, Manoranjan Kumar, R. Nath, Phys. Rev. B 108, 134420 (2023).

27. Spontaneous Hall effect in the magnetic Weyl semimetallic $Eu_2Ir_2O_7$ (111) thin films.
M. Ghosh, D. Samal, and P. S. Anil Kumar, Applied Physics Letters 123, 213101 (2023).

28. Thermoremanent magnetization and Raman study in weak ferromagnet $FeBO_3$
N. Pattanayak, M. Pradhan, P. Panda, B. Giri, G. K. Pradhan, D. Samal, Journal of magnetism and magnetic materials 588, 171453 (2023).

29. Magnetic anisotropy and magnetocaloric effect in Gd_2NiMnO_6 thin films.
A. Ghosh, R. Roy, R. C. Sahoo, S. N. Sarangi, M. Ghosh, D. Mazumdar, D. Samal, P. S. Anil Kumar, Z. Hossain, S. Kanungo, C. Sow, Phys. Rev. B 108, 214423 (2023).

30. Evolution of ferrimagnetism against Griffiths singularity in calcium ruthenate.
P. Kesarwani, S. N. Sarangi, D. Samal, C. Sow, J. Phys.: Condens. Matter 36, 265603 (2024).

31. Investigating the effect of H+-ion irradiation on layered á-MoO_3 flakes by defect engineering.
Ravindra Kumar, V. Mishra, T. Dixit, S. N. Sarangi, D. Samal, M. Miryala, P. K. Nayak, M. S. Rao, Applied Physics Letters 123, 151104 (2023).

32. Emergent quantum transport due to quenched magnetic impurity scattering by antiferromagnetic proximity in $SrCuO_2/SrIrO_3$
S. Jana, T. Senapati, S. G. Bhat, S. N. Sarangi, K. Senapati and D. Samal, Phys. Rev. B 107, 134415 (2023).

33. Unusual structural rearrangement and superconductivity in infinite layer cuprate superlattices.
D. Samal, N. Gauquelin, Y. Takamura, I. Lobato, E. Arenholz, S. V. Aert, M. Huijben, Z. Zhong, Jo Verbeeck, G. Van Tendeloo, and G. Koster, Physical Review Materials 7, 054803 (2023).

34. Valleytronics: A New Way to Communicate With Electrons.
J. Khatei, B. Ojha and D. Samal, Resonance 28, 537 (2023).

35. $Fe_{2-x}Cu_xSnS_4$: Synthesis, structure and magnetic properties of a series of disordered spinels.
P. Agasti, S. Panda, A. Mishra, S. N. Sarangi, D. Samal, N. Mohapatra, S. L. Samal, Journal of Solid State Chemistry 335, 124707 (2024).

36. Observation of Second-Order Phase Transition in Canted Anti-ferromagnet á-$Cu_2V_2O_7$ Using Magnetocaloric Effect.
A. N. ESR, S. N. Sarangi, D. Samal, B. C. Behera, ACS Applied Electronic Materials (2024).

37. Magnetic coupling at the interface between ultrathin tetragonal CuO and $La_{0.7}Sr_{0.3}MnO_3$
D. Palai, R. Kumar, M. Tahir, P. Gupta, S. N. Sarangi, S. Bedanta, G. Tripathy, S. Mukhopadhyay, Z. Hossain, D. Samal, Physical Review B 109 (14), 144423 (2024).

38. Magnetic anisotropy and magnetocaloric effect in thin films.
A. Ghosh, R. Roy, R. C. Sahoo, S. N. Sarangi, M. Ghosh, D. Mazumdar, D. Samal, P. S. Anil Kumar, Z. Hossain, S. Kanungo, C. Sow, Physical Review B 108 (21), 214423 (2023).

39. Electronic Transport and Fermi Surface Topology of Zintl phase Dirac Semimetal $SrZn_2Ge_2$.
M. K. Hooda, A. Chakraborty, S. Roy, A. Agarwal, P. Mandal, S. N. Sarangi, D. Samal, V. P. S. Awana, Z. Hossain, arXiv preprint arXiv:2310.10621 (2023).

40. Investigating the effect of H+-ion irradiation on layered á-MoO3 flakes by defect engineering.
R. Kumar, V. Mishra, T. Dixit, S. N. Sarangi, D. Samal, M. Miryala, P. K. Nayak, M. S. Rao, Applied Physics Letters 123 (15), (2023).

41. Crystal structure and magnetic properties of the spin- frustrated two-leg ladder compounds.
P. Biswal, S. Guchhait, S. Ghosh, S. N. Sarangi, D. Samal, D. Swain, M. Kumar, R. Nath,Physical Review B 108 (13), 134420, 2023.

42. Room temperature synthesis of structure–morphology tuned copper-doped ZnO nanorods and their photo-physics.
S. N. Sarangi, R. K. Sahoo, A. K. Manna, P. Dash, S. K. Choudhury, S. Varma, Journal of Materials Science: Materials in Electronics 34 (22), 1610 (2023).

Condensed Matter Physics (Theory)

43. Clustering and finite size effects in a two-species exclusion process.
J. Chacko, S. Muhuri and G.Tripathy, Indian J. Phys. 98, 1553 (2023).

44. Projective symmetry group classification of Abrikosov fermion mean-field ansätze on the square-octagon lattice.
A. Maity, F. Ferrari, R. Thomale, S. Mandal, and Y. Iqbal. Phys. Rev. B 107, 134438, (2023).

45. Multiple higher-order topological phases with even and odd pairs of zero-energy corner modes in a C3symmetry broken model.
S. Saha, T. Nag and S. Mandal. Europhysics Letters, 142 (5), 2023

46. Higher-order topological corner and bond-localized modes in magnonic insulators.
S. Bhowmik, S. Banerjee and A. Saha, Phys. Rev. B 109, 104417 (2024).

47. Second-order topological superconduct-or via noncollinear magnetic texture.
P. Chatterjee, A. K. Ghosh, A. K. Nandy and A. Saha. Phys. Rev. B (Letter) 109, L041409 (2024).

48. Topological Superconductivity by Engineering Noncollinear Magnetism in Magnet/ Superconductor Heterostructures: A Realistic Prescription for 2D Kitaev Model.
P. Chatterjee, S. Banik, S. Bera, A. K. Ghosh, S. Pradhan, A. Saha, and A. K. Nandy. Phys. Rev. B (Letter) 109, L121301 (2024).

49. Engineering anomalous Floquet Majorana modes and their time evolution in helical Shiba chain.
D. Mondal, A. K. Ghosh, T. Nag and A. Saha. Phys. Rev. B (Letter) 108, L081403 (2023)

50. Thermoelectric properties of inversion symmetry broken Weyl semimetal-Weyl superconductor hybrid junctions.
R. Saxena, N. Basak, P. Chatterjee, S. Rao and A. Saha. Phys. Rev. B 107, 195426 (2023)

51. Generation of higher-order topological insulators using periodic driving.
A. K. Ghosh, T. Nag and A. Saha. J. Phys.: Condens. Matter 36, 093001 (2024).

52. How reciprocity impacts ordering and phase separation in active nematics?
A. Sinha, D. Chaudhuri. Soft Matter 20, 788 (2024).

53. F-box protein FBXB-65 regulates anterograde transport of UNC-104 through modification near the PH domain.
V. Sabharwal, P. P. Boyanapalli, A. Shee, M. L. Nonet, A. Nandi, D. Chaudhuri, S. P. Koushika. Journal of Cell Science 137 (7), jcs261553 (2024).

54. Exact moments and re-entrant transitions in the inertial dynamics of active Brownian particles.
M. Patel, D. Chaudhuri, New Journal of Physics 25, 123048 (2023).

55. When does an active bath behave as an equilibrium one.
S. S. Khali, F. Peruani, D. Chaudhuri. Phys. Rev. E 109, 024120 (2023).

56. Cooperation and competition in the collective drive by motor proteins: mean active force, fluctuations, and self-load.
C. Karan & D. Chaudhuri. Soft Matter 19, 1834 (2023).

57. Inertia and Activity: Spiral transitions in semi-flexible, self-avoiding polymers.
C. Karan, A. Chaudhuri, D. Chaudhuri. arXiv:2404.15748(2024).

58. Impact of chirality on active Brownian particle: Exact moments in two and three dimensions.
A. Pattanayak, A. Shee, D. Chaudhuri, A Chaudhuri.arXiv:2404.09650(2024).

59. Exact moments for trapped active particles: inertial impact on steady-state properties and re-entrance.
M. Patel, D. Chaudhuri. arXiv: 2404.01107 (2024).

60. Dynamical crossovers and correlations in a harmonic chain of active particles.
S. Paul, A. Dhar, D. Chaudhuri. arXiv: 2402.11358 (2024).

61. Active stop and go motion: a strategy to improve spatial exploration?
F. Peruani, D. Chaudhuri.arXiv: 2306.0564 7 (2023).

High Energy Physics (Theory)

62. Flavor-dependent long-range neutrino interactions in DUNE & T2HK: alone they constrain, together they discover.
M. Singh, M. Bustamante, S. K. Agarwalla, Journal of High Energy Physics 08 (2023) 101.

63. Present and future constraints on flavor-dependent long-range Interactions of high-energy astrophysical neutrinos
S. K. Agarwalla, M. Bustamante, S. Das, A. Narang.Journal of High Energy Physics 08 113 (2023)

64. Constraining Lorentz Invariance Violation with Next-Generation Long-Baseline Experiments
S. K. Agarwalla, S. Das, S. Sahoo, P. Swain.Journal of High Energy Physics 07 216 (2023)

65. Enhancing Sensitivity to Leptonic CP Violation using Complementarity among DUNE, T2HK, and T2HKK
S. K. Agarwalla, S. Das, A. Giarnetti, D. Meloni, M. Singh,E. Physical Journal C 83 8 (2023).

66. Measurement of Atmospheric Neutrino Mixing with Improved IceCube DeepCore Calibration and Data Processing.
R. Abbasi, M. Ackermann, J. Adams, S. K. Agarwalla et al.,Physical Review D 108 (2023) 1, 012014.

67. Exploring Long-Range Interactions of $L_m - L_t$ symmetry at INO – ICAL.
A. Khatun, S. K. Agarwalla. PoS TAUP2023 (2024) 269.

68. Probing the interior of Earth using oscillating neutrinos at INO – ICAL.
A. K. Upadhyay, A. Kumar, S. K. Agarwalla, A. Dighe. PoS (EPS-HEP2023) 198.

69. Neutrino Oscillations in the Earth: A Unique Tool to Probe Dark Matter Inside the Core
A. K. Upadhyay, A. Kumar, S. K.

Agarwalla, A. Dighe. Phys.Sci.Forum 8 (2023) 1, 54.

High Energy Physics (Theory)

70. Topology of Hawking-Page transitionn in Born-Infeld AdS black holes.
P. K. Yerra, C. Bhamidipati, S. Mukherji. J. Phys. 2667,1, 012031 (2023).

71. Cardy-Verlinde formula from boundary matrix model.
P. K. Yerra, C. Bhamidipati, S. Mukherji. e-Print,2312,10783 [hep-th]
.

72. Topology of critical points in boundary matrix duals.
P. K.Yerra, C. Bhamidipati, S. Mukherji. JHEP 03, 138 (2024) .

73. Dependence of Thermodynamic Quantities at Freeze-out on Pseudorapidity and Collision Energy in pp Collisions at LHC Energies.
P. K. Sahu, et. al. Paper reviewed for J. Phys. G: Nucl. Part. Phys.

74. Study of strangeness and baryon production through angular correlations between Xi baryons and identified hadrons in pp collisions at sqrt{s} = 13 TeV.
P. K. Sahu et.al. Paper review for ALICE collaboration.

75. Fermionic dark matter in Dynamical Scotogenic Model.
E. J. Chun, A. Roy, S. Mandal & M. Mitra. JHEP 08, 130 (2023).

76. Type-II see-saw at ì+ì" collider
S. P. Maharathy, M. Mitra.Phys. Lett. B 844, 138105 (2023).

77. An alternate left-right symmetric model with Dirac neutrinos.
S. P. Maharathy, M. Mitra, A. Sarkar Eur.Phys.J.C 83, 6, 480 (2023).

78. Radiative neutrino mass with electroweak scale Majorana dark matter in the Scotogenic model.
Avnish, K. Ghosh. e-Print: 2302.03634 [hep-ph], Nucl.Phys.B 1002, 116524 (2024).

79. Unveiling the secrets of new physics through top quark tagging.
R. Sahu, S. Ashanujjaman and K. Ghosh,
10.1140/epjs/s11734-024-01257-5, EPJS-D-24-00218R2

80. Singlet-Doublet Fermionic DarkMatter in Gauge Theory of Baryons
Taramati, U. Patel, R. Sahu, S. Patra, K. Ghosh. 10.1007/978-981-97-0289-3_226, Springer Proc.Phys. 304, 875-877 (2024).

81. Searching for Scalar Leptoquarks at the LHC/FCC and a Muon Collider
S. Parashar, P. Bandyopadhyay, A. Karan, R. Mandal, Avnish et al..10.22323/ 1.450.0240, PoS LHCP2023, 240 (2024).

82. Development of the CMS detector for

the CERN LHC Run 3.
A. Hayrapetya, A. Nayak, S. Varghese,et. al..CMS Collaboration, arXiv: 2309.05466.

83. Invariant mass reconstruction of heavy gauge bosons decaying to tau leptons using machine learning techniques .
V. K. MB, A. K. Nayak, Eur.Phys. J.C 84,3, 219 (2024) .

Theoretical Nuclear Physics

84. Linkage among incompressibility and its enduring impact on fu- sion cross sections.
S. Rana, M. Bhuyan, S. K. Patra and R. Kumar, Phys. Rev. C 109,044613 (2024).

85. Reply to the "Comment on Effect of density and nucleon-nucleon potential on the fusion cross section within the relativistic mean field formalism.
M. Bhuyan, R. Kumar, S. Rana, D. Jain, S. K. Patra and B. V. Carlson, arXiv:2312.10452.

86. Alpha clustering in 41, 45,49Ca* formed in neutron induced reac-tions.
M. Kaur, B. B. Singh, S. K. Patra and P. K. Raina, Journal of Physics: 2663 (1), 012049 (2023).

87. Nuclear incompressibility and its enduring impact on fusion cross-section.
S. Rana, M. Bhuyan, and S. K. Patra, and R. Kumar, Physical Review C, (2024).

88. Influence of dark matter on magnetized neutron stars, Vishal Parmar.
H. C. Das, M. K. Sharma, and S. K. Patra, Phys. Rev. D 108, 083003 (2023), arXiv preprint arXiv:2306.17510.

89. Quarkyonic Model for Neutron Star Matter: A Relativistic Mean- Field Approach.
A. Kumar, D. Dey, S. Haque, R. Mallick, S. K. Patra, arXiv:2304.08223.

90. Surface and decay properties of newly synthesized 207,208Th isotopes for various á"decay chains.
J. A. Pattnaik, R. N. Panda, M. Bhuyan, and S. K. Patra, Nucl. Phys. A 1038, 122722 (2023).

91. Structure and reaction study of Z=120 isotopes using non-relativistic and relativistic mean-field formalism.
J. A. Pattnaik, K. C. Naik, R. N. Panda, M. Bhuyan and S. K. Patra, Pramana, 97, 136 (2023).

92. Theoretical studies on structural properties and decay modes of 284"375 119
Isotopes.
A. A. Rather, M. Ikram, I. A. Rather, A. A. Usmani, B. Kumar, K. P. Santhosh and S. K. Patra, The European Physical Journal Plus 138, 467 (2023).

93. Constraining the surface curvature of an anisotropic neutron star.
H.C. Das, J. A. Pattnaik and S. K. Patra, Phys. Rev. D, 107, 083007 (2023).

94. Fusion enhancement within a collective clusterization approach applied to the isotopic chain of neutron-rich light-mass compound nuclei.
S. Kaur, N. Kaur, R. Kaur, B. Singh, and S. K. Patra, Phys. Rev. C107, 014613 (2023).

95. Magnetized neutron star crust within effective relativistic mean-field model. V. Parmar, H. C. Das, M. K. Sharma, and S. K. Patra, Phys. Rev. D 107, 043022 (2023).

CMS Collaboration

96. IOP is a part of CMS Collaboration (Dr. A. K. Nayak) has published about 85 papers during this period.

ALICE Collaborations

97. IOP is a part of ALICE collaboration (Prof. P.K. Sahu) and total number of publications for the year 2023-2024 are 88.
We listed only those ones where we have made direct contributions. However, all the publications include us as author due to our many indirect contributions

From the Desk of Retired Faculty Members

98. On Production of Excited Kaluza-Klein States in Large Radius Compactification Scenario.
J. Maharana et.al. DOI : 10.1142/S0217751X23500598

99. Pulsar as a Weber detector of gravitational waves and a probe to its internal phase transitions.
P. Bagchi, O. Ganguly, B. Layek, A. Sarkar, A. M. Srivastava, Invited Review Article, Mod. Phys. Lett. A39, 14, 2430004 (2024).

100. Percolating cosmic string loops from evaporating primordial black holes.
A. M. Srivastava, Phys. Lett. B 853, 138683 (2024).

Publication by Others Members

1. A New Technique for Synthesis of the Cu3N and its Structural Indexing
B. Mallick, A. Rajak, S. Giri, L. Behera, B. Parija, P. Mallick, V. Senthil, S. Panigrahi, Indian. J. Phys.; 10.1007/s12648-024-03178-4

2. Effect of elementals inside Bacopa monnieri herb due to acid attack
S. Behera and B. Mallick, Int. J. Biol. and Biomed., 8, 27-33, (2023).

3. Nonlinear X-ray Compton Scattering: A new mathematical model for X-ray wave mixing mechanism

4. Effect of elementals inside Bacopa monnieri herb due to acid attack
S. Behera and B. Mallick, Int. J. Biol. and Biomed., 8, 27-33, (2023).

5. Nonlinear X-ray Compton Scattering: A new mathematical model for X-ray wave mixing mechanism
B. Mallick, Physics Open 14, 100137, (2023).

6. Cold plasma as a Competent Approach to Treat Solid Fiber of Ichnocarpus Frutescens: PIXE, XRD, Raman, FT-IR , and SEM Analysis, Braz
S. Rout, B. Mallick and C. Parida, J Phys 53, 53 (2023).

7. A Study of the Nobel Laureates in Peace. RBU Journal of Library & Information Science

Sahoo, J. Mohanty, B. Mandal, S. & Sethy, M, Fascinating Field of the Peace World:,25, 110-116 (2023).

8. Annals of Library and Information Studies
Sahoo, J. Karadia, A. & Mohanty, B, 70(Dec, 2023), 171-179, DOI: 10.56042/alis.v70i4.5341

3.2 Papers Published in Conference Proceedings

1. Role of cationic size mismatch and effect of disorder in mixed valent manganites
A. Khatun, P. Aich and D. Topwal, AIP Advances 13, 025125 (2023).

2. Effect of A-site cationic ordering on the specific heat of mixed valent manganites
Khatun, D. Topwal, AIP Conference Proceedings 2995 (1) (2024).

3. Phenomenology of Scalar Leptoquarks: Neutrino Mass, $g-2$, and B-Anomalies.
S. Parashar, P. Bandyopadhyay, A. Karan, R. Mandal, Avnish et al., Phys. 304, 919-921 (2024).

4. Establishing non-maximal 2-3 mixing with DUNE in light of current neutrino oscillation data
S. K. Agarwalla, R. Kundu, S. Prakash, M. S. Zenodo, Contribution to proceedings of the 30th International

Bhattacharjee, Proceeding of 66th DAE Solid State Physics Symposium.

Book Published/Book Chapter Published:

1. Multifragmentation in Heavy-Ion Reactions: Theory and Experiments
Editors : M. Kaur, A. Kumar, A. Quddus, M. Bhuyan, S. K. Patra,
Jenny Stanford Publishing Pte. Ltd., (2023) (eBook ISBN9781003385134)

2. Nanomaterials in biosensors Applications in the Medical Field
Editors: R. K. Sahoo, S. K. Singh, R. S. Mane, S. Varma (Nanomaterials for Sustainable Development in Biosciences- Opportunities and Future Perspectives) Springer Nature, Singapore (2023) 313- 334 (DOI: 10.1007/978-981-99-1635-1)

3. Cold Plasma Technique and Applications
Editors: S. Rout, B.Mallick and C. Parida,
LAP LAMBERT Academic Publishing GmbH & Co., Germany (2024).
ISBN 978-620-7-80523-5

4. Nanomaterials in biosensors for Medical Applications, by Rakesh K. Sahoo, Saroj Kumar Singh, Rajaram S. Mane, Shikha Varma, in Nanomaterials for Sustainable Development in Biosciences- Opportunities and Future Perspectives, published by Springer Nature, Singapore (2023) 313- 334 (doi: 10.1007/978-981-99-1635-1

3.3 Publications by Visitors of the Institute

1. Low dimensional structural derivatives of Carbon from HiPCO SWCNTs
S. Saini, G. M. Gouda and K.

Chapter 4

OTHER ACTIVITIES

4.1. Foundation Day

The Institute of Physics, Bhubaneswar, marked a momentous occasion as it celebrated its 49th Foundation Day on September 4th, 2023. The Institute hosted a series of noteworthy events on its premises to commemorate its rich history and significant contributions to the field of physics.

Distinguished physicist Prof. Pinaki Majumdar, the Director of the Harish-Chandra Research Institute, Prayagraj (Allahabad), graced the event as the Chief Guest. Prof. Majumdar shared invaluable insights into the role and enduring relevance of research institutions within the broader educational landscape of India. The event, held under the able leadership of Prof. K. K. Nanda, Director of the Institute of Physics, Bhubaneswar, featured a stimulating discussion on the Institute's academic and research endeavours. The event was a grand success due to the meticulous plan and presence of programme committee members, namely Prof. B. R. Sekhar, Chairman, FDC-2023, Dr. S. N. Sarangi, Registrar, and Dr. Basudev Mohanty, Convener of the programme. The celebration culminated in a vibrant Cultural Programme showcasing the Institute's community's diverse talents and artistic expressions. The Institute of Physics, Bhubaneswar, looks forward to another year of academic excellence and continued contributions to the world of physics as it begins its 50th year of existence.

4.2 National Science Day 2024 with Emphasis on Indigenous Technologies for Viksit Bharat:

The Institute of Physics (IOP), Bhubaneswar, joyously commemorated National Science Day 2024 (NSD-2024) under the theme of "**Indigenous Technologies for Viksit Bharat**," paying homage to the scientific accomplishments and aspirations of our nation. This year holds exceptional significance as IOP also marks its **Golden Jubilee Celebration**. In light

of this momentous milestone, IOP was committed to elevating the NSD-2024 event, ensuring an unmatched experience for all participants and attendees.

The primary objective of this celebration was to uplift the stature of science, igniting the scientific spirit, and fostering a love for knowledge among the people of our country. As part of the festivities, IOP hosted an "**OPEN DAY**" event on February 28, 2024, from 10:00 am to 05:00 pm, at its premises. The event showcased a diverse array of engaging activities, including live demonstration experiments, laboratory visits, and scientific poster presentations. Students, educators, parents, media representatives, and the general public were warmly invited to join the day-long activities and immersed themselves in the captivating realm of science. The event commenced with the inauguration by Prof. K. K. Nanda, Director of the Institute of Physics, Bhubaneswar, in the presence of Dr. S. Sarangi, Registrar, and Prof. P. K. Sahu, Chairman of NSD-2024.

Approximately 1000 students and educators enthusiastically explored the various stalls, actively engaged in numerous activities, and departed with smiles, enriched by a truly rewarding experience. Attendees wholeheartedly seized the opportunity to delve into the wonders of science at IOP, aligning with IOP's ongoing journey of collective discovery and innovation.

4.3. Outreach Programme

Promoting Science and Cleanliness for Environmental Sustainability:

The Institute of Physics (IOP), Bhubaneswar, has been at the forefront of promoting scientific awareness and environmental sustainability through various initiatives. This report highlights the key events and activities organized by IOP to foster a love for science and emphasize the importance of cleanliness for national development and environmental sustainability.

India International Science Festival (IISF-2023):

As part of the India International Science Festival (IISF-2023), IOP hosted an "Outreach Program" showcasing its diverse research activities and experimental facilities. The event aimed to ignite scientific curiosity among students, teachers, and the general public. Participants explored various laboratories and experimental setups, experiencing firsthand the cutting-edge research conducted at IOP.

"Swachhata Hi Seva" Campaign 3.0:

The "Swachhata Hi Seva" programme was organized at IOP in two phases. The first phase ran from 15th September 2023 to 30th September 2023, and the second phase from 1st October 2023 to 31st October 2023. Led by Prof. Karuna Kar Nanda, with support from entire IOP family, the campaign focused on cleanliness drives in and around the IOP campus.

Key activities included:

- Cleaning of Biseswar Basti on 1st October, involving 120 participants.
- Cleaning of the New Hostel and nearby areas on 2nd October.
- Cleaning of the Govt. Primary School in Delta Colony on 9th October.
- Office and medical rooftop cleaning on 14th October.
- Cleaning of the Lingaraja Temple and nearby areas on 16th October.
- Tree plantation and clean-up at Ashram Vidyalaya Govt. School on 18th October.
- Cleaning of Udayagiri and Khandagiri caves on 20th October.
- Cleaning of IBL and nearby areas on 21st October.
- Cleaning of Dhauli Shanti Stupa on 31st October.

The events and initiatives organized by IOP, Bhubaneswar, have significantly contributed to promoting scientific awareness and environmental sustainability. The "Swachhata Hi Seva" campaign not only enhanced physical cleanliness but also raised awareness about the importance of a clean environment. The IISF-2023, National Science Day - OPEN DAY, and various Outreach and Lab visit programs have ignited scientific curiosity and fostered a love for knowledge among participants. These efforts reflect IOP's commitment to national development and environmental sustainability.

IOP, Bhubaneswar expresses its gratitude to the Department of Atomic Energy (DAE) for providing the opportunity to participate in these initiatives. IOP will continue to organize such programs to promote science and cleanliness, contributing to the vision of a developed and sustainable Bharat.

4.4 REPORT ON G-20 JAN BHAGIDARI EVENT during 1st April - 22nd April 2023

To raise awareness and imbibe the spirit of participation and ownership with India's G20 presidency in the state, the Institute of Physics (IoP), Bhubaneswar as a Standalone Institute conducted a series of events from 1st April 2023 to 22nd April 2023 in the form of Seminars, Webinars, Competitions, Exhibitions, and other programs like Tribes of Odisha, Coastal Development etc. showcasing the rich cultural heritage and economic potential of the state. IoP started the Jan Bhagidari series of events (an initiative under India's G20 Presidency) on the auspicious day of the Utkal Divas.

From day one of the Jan Bhagidari events, IOP carried out Swachhata Aviyan at Chandrabhaga Beach, Konark, Puri and conducted Quiz competition for the students of Jawahar Navodaya Vidyalaya (JNV), Konark, Puri district. Prof. K. K. Nanda, Director; Prof. P. K. Sahu, Registrar; Dr. S. N. Sarangi, Convener, Dr B. Mallick and other officials were present.

On the eve of the Jan Bhagidari events, two science outreach programmes were conducted at E-Tech Residential Degree College, Dhenkanal on 10th April 2023 and at Salipur Autonomous College, Salipur on 15th April 2023. Prof. K. K. Nanda, Director, Dr. S. N. Sarangi, Convener along with Dr B. Mallick, IoP delivered a series of lectures on "Future Sources of Energy" and "Nuclear Energy" that is in accordance with the theme given to IoP by 3rd G-20 Education Working Group (EWG) Meeting Committee. Moreover, quiz competitions were organized at E-Tech Residential Degree College, Dhenkanal and Salipur Autonomous College, Salipur aiming the Jan Bhagidari concept among the students. Apart from these, a Seminar was arranged "Climate Change" by Mr. Sidhanta Das, Retd. IFS on 13th April, 2023 and a webinar on the "Magnus Effect" delivered by Prof. Sanjay Mittal, Department of Aerospace Engineering, IIT Kanpur on 20thApril 2023. Two days Official Language Skill Development Programmes were also conducted at IoP, Bhubaneswar for the Rajbhasa students of Ravenshaw and Rama Devi Universities on 19thand 20thApril 2023. IoP conducted a Book Exhibition on the theme "Science for Society". Faculties, staff members, scholars, students from Utkal University and the Director of IoP attended the program and witness the activities of the Jan Bhagidari program and explore the Book Exhibition.

The month-long program witnessed many other "Jan Bhagidari" programmes like Quiz Competitions, Drawing Competitions, Rangoli competitions, various sports events, cultural events like the Tribal Dance, Odissi dance, Sambalpuri dance, etc., Tree Plantation and Swachhata Aviyan inside as well as outside the Campus, viz. Saptasajya and Kapilash Hills of Dhenkanal district and Chausathi Yogini of Hirapur, Khordha district including Chandrabhaga Beach, Puri district. The programme concluded on 22nd April 2023 with a mega event on "Science Model Contest" where students of different schools and colleges participated followed by a valedictory session with prize distribution. One of the key events was the cultural event performed by underprivileged boys and girls.

These events were part of IoP's efforts to promote the public participation and ownership during India's G20 Presidency.

Schedule of "22 Days G-20 Jan Bhagidari Event"

Day One (01.04.2023)	Quiz Competition at JNV, Konark, Dist. Puri and Swachh Abhiyan at Chandrabhaga, Konark coordinated by S. N. Sarangi & B. K. Mishra
Day Two (02.04.2023)	Cultural Programme by IOP Children, coordinated by S. N. Sarangi, B. Mohanty, R. Mohapatra, & J. Khan
Day Three (03.04.2023)	Food Festival with special focus on millets, coordinated by S. L. Das & L. Sahoo

Day Four (04.04.2023)	Cyclothon, coordinated by S. N. Sarangi, R. Mohapatra, B. K. Mishra, & B. Behera
Day Five (05.04.2023)	Drawing Competition, coordinated by A. Kujur, R. Mohapatra, & P. K. Senapati
Day Six (6.04.2023)	Essay and Debate Competition, coordinated by A. Kujur, R. Mohapatra, & P. K. Senapati
Day Seven (7.04.2023)	Walkathon, coordinated by S. N. Sarangi, B. K. Mishra, B. Behera, B. K. Dash, & R. Mohapatra
Day Eight (8.04.2023)	Swachh Abhiyan, IOP, coordinated by M. V. Vanjeeswaran, R. Mohapatra, & G. Pradhan
Day Nine (9.04.2023)	Swachh Abhiyan at Saptasajya and Kapilash, coordinated by B. Mohanty & J. Khan
Day Ten (10.04.2023)	Science Outreach and Quiz Competition program at ET-Tech Residential College, coordinated by S. N. Sarangi & B. K. Mishra
Day Eleven (11.04.2023)	Yoga Camp & Book Exhibition at IOP, coordinated by M.V. Vanjeeswaran & R. Mohapatra
Day Twelve (12.04.2023)	1) Book Exhibition – I, coordinated by Basudev Mohanty & A. Kujur 2) Essay, drawing, cultural programme by Slum children, coordinated by R. Mohapatra, B. Behera & B. K. Dash
Day Thirteen (13.04.2023)	Webinar on Climate Change, coordinated by Prof. D. Samal
Day Fourteen (14.04.2023)	Cultural Program-Tribal Dance, coordinated by B. Mohanty & J. Khan
Day Fifteen (15.04.2023)	Science Outreach Program and Quiz competition at Salipur College, Dist. Cuttack, coordinated by S. N. Sarangi & B. K. Mishra
Day Sixteen (16.04.2023)	1) Volleyball Match, coordinated by S. K. Choudhury 2) Rangoli Competition, coordinated by R. Mohapatra & L. Sahoo
Day Seventeen (17.04.2023)	Tree Plantation in IOP Campus, coordinated by MV Vanjeeswaran, R. Mohapatra & G. Pradhan
Day Eighteen (18.04.2023)	Quiz Competition for IOP Campus children, coordinated by Basudev Mohanty & B. K. Dash

Day Nineteen (19.04.2023)	Seminar on Official Language Skill Development G20, coordinated by M. Siddhabhatti & B. Behera
Day Twenty (20.04.2023)	1) Hindi Essay competition on G20, coordinated by M. Siddhabhatti & B.Behera 2) Webinar on the Magnus Effect, with speaker Prof. D. Samal
Day Twenty-one (21.04.2023)	1) Celebration of Civil Service Day Programme at Institute of Physics & 2) Swachh Abhiyan at Chausathi Yogini Tample, Near Bhubaneswar.
Day Twenty-two (22.04.2023)	Science Model Contest and Valedictory Function, coordinated by B. Mallick & B. K. Dash)

GLIMPSE OF G-20 JAN BHAGIDARI EVENT


ସମ୍ବାଦ

ସାଲେପୁର ସ୍ୱୟଂଶାସିତ ମହାବିଦ୍ୟାଳୟରେ 'ଆଉଟ୍‌ରିଚ୍' କାର୍ଯ୍ୟକ୍ରମ

IOP G-20 Janbhagidari Activities on Argus News and Sambad Daily


जन-भागीदारी कार्यक्रमों की श्रृंखला शुरू

आजाद सिपाही

12


TO HOST G20
Cyclothan at IoP


Drawing Competition at IOP


Essay Competition at IOP

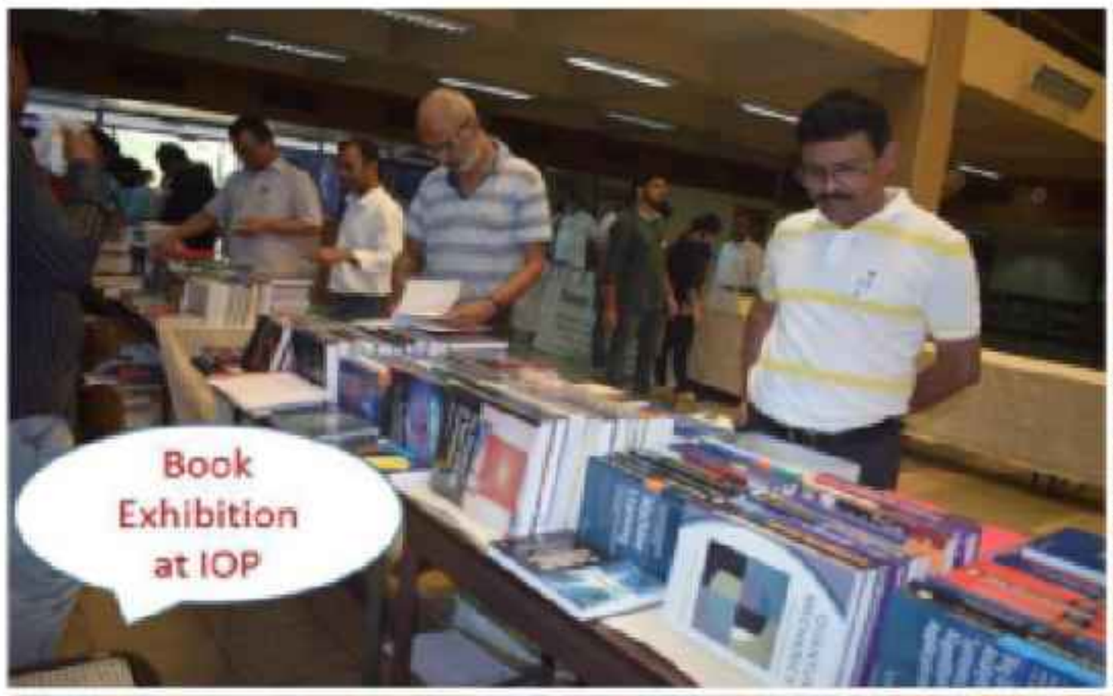

Walkathan at IOP


Science Outreach Program at E-Tech College Dhenkanal


Swachha Aviyan at IOP


Yoga at IOP


Quiz Competition at E-Teach College, Dhenkaanal


Book
Exhibition
at IOP


Swachha
Aviyan at
IoP


MOTHER OF DEMOCRACY
TO HOST G20
Swachha
Aviyan at
Saptasajya


Drawing
Competition by
Slum Children
at IOP


Science
Outreach
Program at
Salipur College


Quiz
completion
at Salipur
College


Essay
competition
by slum
children at
IOP


Cultural
Program at
IOP
MOTHER OF DEMOCRACY
TO HOST G20


Cultural
Program at
IOP

Seminar on Climate Change

Director, IoP - Prof. K. K. Nanda and Nodal Officer Dr. S. N. Sarangi at G-20 Meeting, IMMT, Bhubaneswar

4.5 Van Mahotsav Celebration at IOP:

The Institute of Physics (IoP) Bhubaneswar, a premier autonomous research institute under the Department of Atomic Energy, Government of India, has launched several initiatives aimed at promoting science and cleanliness. These initiatives underscore the institute's commitment to national development and environmental sustainability. One such initiative was the celebration of Van Mahotsav, a festival dedicated to tree planting. Van Mahotsav was inaugurated by Prof. Karuna Kar Nanda, Director of IoP, on July 7, 2024, marking the beginning of the Van Mahotsav week. The event saw enthusiastic participation from over fifty IoP members, who joined in the tree-planting activities. The presence of IoP authorities added significance to the occasion, highlighting the institute's dedication to fostering a green and sustainable environment.

Van Mahotsav, celebrated across India during the first week of July each year, was initiated by the Ministry of Agriculture in 1950. The festival aims to underscore the importance of trees and forests in maintaining ecological balance and ensuring environmental integrity. It encourages the active participation of government officials, non-profit organizations, and volunteers in tree-planting activities. The primary objectives of Van Mahotsav are to promote environmental protection and raise awareness about the crucial role of trees and forests in

combating climate change. Over the years, Van Mahotsav has evolved into a prominent annual event in India, significantly contributing to the country's increased green cover. The festival serves as a reminder of the need for concerted efforts to protect and preserve our natural environment. The IoP's celebration of Van Mahotsav reflects its broader commitment to environmental stewardship and community engagement. Below are some photographs from the Van Mahotsav celebration:

4.6 Sports and Cultural Activities

Along with the research activities, the sports and cultural activities have been promoted through different sports and cultural programs to keep all the members physically fit. To carry out different sports and cultural activities a committee was formed. Institute of Physics Employees Welfare Society (IOPEWS) support the committee in organizing different

Followings are the different activities conducted during the year 2023-24:

1. A football match was organized by IOPEWS and it was held on 15th August, 2023. It was a friendly football match played between Team A (Faculty and Doctoral Scholars) and Team B (Staff of the Institute). This match was won by Team A. Around 115 spectators were present there to enjoy this football match.

2. A friendly Cricket match was also conducted on the occasion of 26th January, 2024. This match was played between Team A (Faculties and Doctoral scholars) and Team B (Staffs of the Institute). It was a very interesting match. Team A won the match. Around 80-viewers joined and made the event successful.

3. During this period IOPEWS organized various types of competitions among the employees of the organization and their family members. These included painting competition (on a given theme), 100 meter race among children. Song, Musical-Chair and Jhoti competition among women of the colony (family members of employees). Bridge, Chess, Badminton, Slow Cycle Race, Tug of War competition among the employees of the Institute. IOPEWS also organized Volleyball match and Kabaddi match during the session. These competitions were organized in three categories according to age. i.e. children of employees were divided into three categories: 0-5 age group, 5-14 years age group, 14 years and above. Various competitions for employees and students of the Institute like playing Carrom board (double and single), Chess competition, Badminton competition, Song competition, Brisk walking competition, successful candidates of children, women and various competitions were felicitated on the eve of Foundation Day.

4. In year 23-24, many members of IoP had selected to play in the various events of Zonal selection matches of the XXXVII Annual DAE Sports and cultural meet. Among them Sri

Jyoti Ranjan Behera selected to play in the final of the DAE Annual Sports and Cultural meet for Table Tennis, organized by Kaiga, Golkunda, Karnatak.


ION DAY CELEBRATION
दिवस समारोह


DATION DAY CELEBRATION
ना दिवस समारोह


FOUNDATION DAY CELEBRATION
स्थापना दिवस समारोह


FOUNDATION DAY CELEBRATION
स्थापना दिवस समारोह


FOUNDATION DAY CELEBRATION
स्थापना दिवस समारोह


ION DAY CELEBRATION
दिवस समारोह


FOUNDATION DAY CELEBRATION
स्थापना दिवस समारोह


NDATION DAY CELEBRATION
पना दिवस समारोह

4.7 Official Language Implementation: Hindi Fortnight-2023:

The Hindi Day celebrations and the inaugural ceremony of Hindi Fortnight at the Institute of Physics were held on 14 September 2023 starting from the All India Official Language Conference organized by the Department of Official Language, Government of India at Pune, Maharashtra and culminating on 29 September 2023. During this fortnight, various competitions were organized for the staff and students of the Institute.

As part of the fortnight, a state level Hindi essay competition was organized for undergraduate and postgraduate Hindi students of various universities in Odisha. Students of Ramadevi Women's University, Utkal University and Ravenshaw University participated in it and the first three students were awarded.

Rajbhasha Kaushal Vikas Karma

As a public interest program, the Institute organized Rajbhasha Kaushal Vikas Program for Hindi postgraduate students on 25.09.2023. Students from Ramadevi Mahila Vishwavidyalaya, Utkal University and Ravenshaw University participated in this program. In this program, Shri Hariram Pansaru, STPI, Bhubaneswar delivered a lecture on Artificial Intelligence and Applications of Hindi, Dr. Saurabh Chawla, NISER, Bhubaneswar delivered a lecture on the role of Hindi language in scientific research and Shri Akhileshwar Singh, Principal, Experimental Purpose School, Bhubaneswar delivered a lecture on New Education Policy-2020 and Indian Languages.

Prize distribution and closing ceremony:

A prize distribution ceremony was organized on 29 September 2023 to give prizes to the winners of the competitions organized during the Hindi Pakhwada Festival. On this occasion, Director Prof. Karunakar Nanda, Dr. S. N. Sharangi, Registrar gave prizes to the winners of various competitions.

Chapter 5

FACILITIES

5.1 MAJOR EXPERIMENTAL FACILITIES

ION BEAM FACILITIES

The Ion Beam Laboratory houses the NEC 3 MV tandem Pelletron Accelerator which is one of the major facilities used by researchers from all over the country. The accelerator provides ion beams of energies typically 1-15 MeV starting from protons and alphas to heavy ions. Commonly used ion beams are that of H, He, C, N, Si, Mn, Ag and Au. Multiple charge states are possible for the MeV energy positive ion beams. Argon is used as the stripper gas to produce positive ions. The most probable charge state for heavy ions (carbon or above) is 3+ for terminal potentials above 2 MV.

The beam hall has six beam lines. The beam line at -45° is used for Rutherford Backscattering (RBS), Elastic Recoil Detection Analysis (ERDA), Proton induced X-ray Emission (PIXE), Ultra high vacuum (UHV) and ion channeling. A general purpose scattering chamber suitable for PIXE experiments is available in the 0° line. This beam line also has the potential to perform external PIXE experiments in atmosphere. The 15° beam line is equipped with a raster scanner and is being used for ion implantation. There is a UHV chamber for surface science experiments in the 30° beam line. The 45° beam line houses the micro-beam facility.

The electron cyclotron resonance (ECR) ion source for ion implantation, nanoscale patterning, ion-beam induced epitaxial crystallization, ion beam mixing, ion-beam shaping and synthesis of embedded nanostructures and so on. At Surface Nano structuring and Growth (SUNAG) Laboratory, we have facilitated a low energy (50eV-2 keV), broad beam (I in. diameter) electron cyclotron resonance (ECR) source based ion beam etching facility for creating self-organized surface nanostructures.

MICROSCOPY FACILITIES

The High Resolution Transmission Electron Microscope (HRTEM) facility consists of two components: Jeol 2010 (UHR) TEM and Associated Specimen Preparation system. High-Resolution Transmission Electron Microscopy (HRTEM) with an ultra-high resolution pole-piece (URP22) working at 200 keV electrons from LaB6 filament assures a high quality lattice imaging with a point-point to resolution of 0.19 nm.

ARUPS FACILITIES

The Angle Resolved Ultraviolet Photoelectron Spectrometer (ARUPS) is equipped with facilities for doing both angle integrated valence band measurements as well as angle resolved valence band measurements. The angle resolved studies are possible on single crystals.

PULSED LASER DEPOSITION (PLD) SYSTEM

PLD system helps growing epitaxial thin films of various materials albeit the most preferred materials are oxides. The newly installed system was developed in a piece-wise manner by procuring several modules from different sources. We are depositing epitaxial bi- and multi-layer thin films of superconducting (viz. YBCO) and colossal magneto-resistance (viz. LSMO) on suitable substrates.

MAGNETIC PROPERTY MEASUREMENT FACILITY

The SQUID-VSM lab consists of the Quantum Design MPMS SQUID-VSM EVERCOOL system. The magnetic property measurement system (MPMS) is a family of analytical instruments configured to study the magnetic properties of samples over a broad range of temperatures and magnetic fields. Extremely sensitive magnetic measurements are performed with superconducting pickup coils and a Superconducting Quantum Interference Device (SQUID).

OPTICAL PROPERTY MEASUREMENT FACILITY

The Micro Raman facility is operated in backscattering geometry. Confocal mapping capabilities with sub-micron spatial resolution are possible. A wide range of excitation wavelengths, using laser, is possible allowing control of the penetration depth into the material, and thus, control of the volume sampled.

5.2 COMPUTER CENTRE

The computer centre facilitates the scientific community dedicatedly in terms of scientific computation and In-House IT facilities. The centre is responsible for managing information and communication technology infrastructure in the Institute. The centres activity ranges from administration (server, network, etc.), and hosting various services to laptop/desktop & user support. The Centre provides support in a hybrid environment consisting of different operating systems such as Unix-based (Cent OS, Redhat, Fedora, Ubuntu), MS Windows and MAC OS. Our Data centre activities have a state-of-the-art mechanism to handle system administration which includes mail services, a centralized storage solution with a backup facility and in-house development of web and intranet and gigabit network connectivity. In order to accomplish our Data centre activities, we have installed high-end servers, core, distribution, access layer network switches, Firewall (UTM) and load balancer. Wireless network is available across all the buildings in campus. Internet facility is extended to residence area through Asynchronous Data Subscriber Line (ADSL).

The centre manages over 200 Desktops, Laptops, Software and License (Mathematica, Matlab, Origin etc.), and Closed Circuit Television (CCTV) based surveillance systems installed at several offices and laboratories. A number of heavy duty printers are installed at

different locations of academic building for general printing over LAN using terminal and through Web using online printing facility.

Institute has leased line Internet connectivity from one Internet Service Provider (ISPs) of 100 Mbps and 1 Gbps network connectivity by National Knowledge Network (NKN). The Institute operates over its own IP addresses from the Indian Registry for Internet Names and Numbers (IRINN). The Institute is a part of the EDUROAM facility.

The centre provide technical support for administrative work, such as accounting, personnel management, stores management. Several software packages such as MSOffice, Wings 200 Net, Tally and multilingual software are in use.

The center conducts training, workshop and awareness programs in relevant areas time to time.

5.3 SAMKHYA (8>M/): High Performance Computing Facility

SAMKHYA (8>M/) - High Performance Computing (HPC) Facility at the Institute is a hybrid environment that consists Sixty (60) Compute Nodes, two (2) Master Nodes, Four (4) I/O nodes (OSS & MDS) and 50 TB of object storage, QDR Infiniband interconnect and 1 Gbps Local Area Network. The infrastructure is of two (2) precision ACs (10 tons of refrigeration each) and uninterrupted supply through three (3) 40KVA & one (1) 60 KVA UPS to facilitate the system. The facility consists of 1440 CPU cores, 40 NVIDIA Tesla K80 cards and 40 Intel Xeon Phi 7120P.

This facility has been ranked in the list of top supercomputers in India by CDAC, Bengaluru (January 2018 report at http://topsc.in). The facility is acknowledged in various publications by the user community.

5.4 ANUNET FACILITY

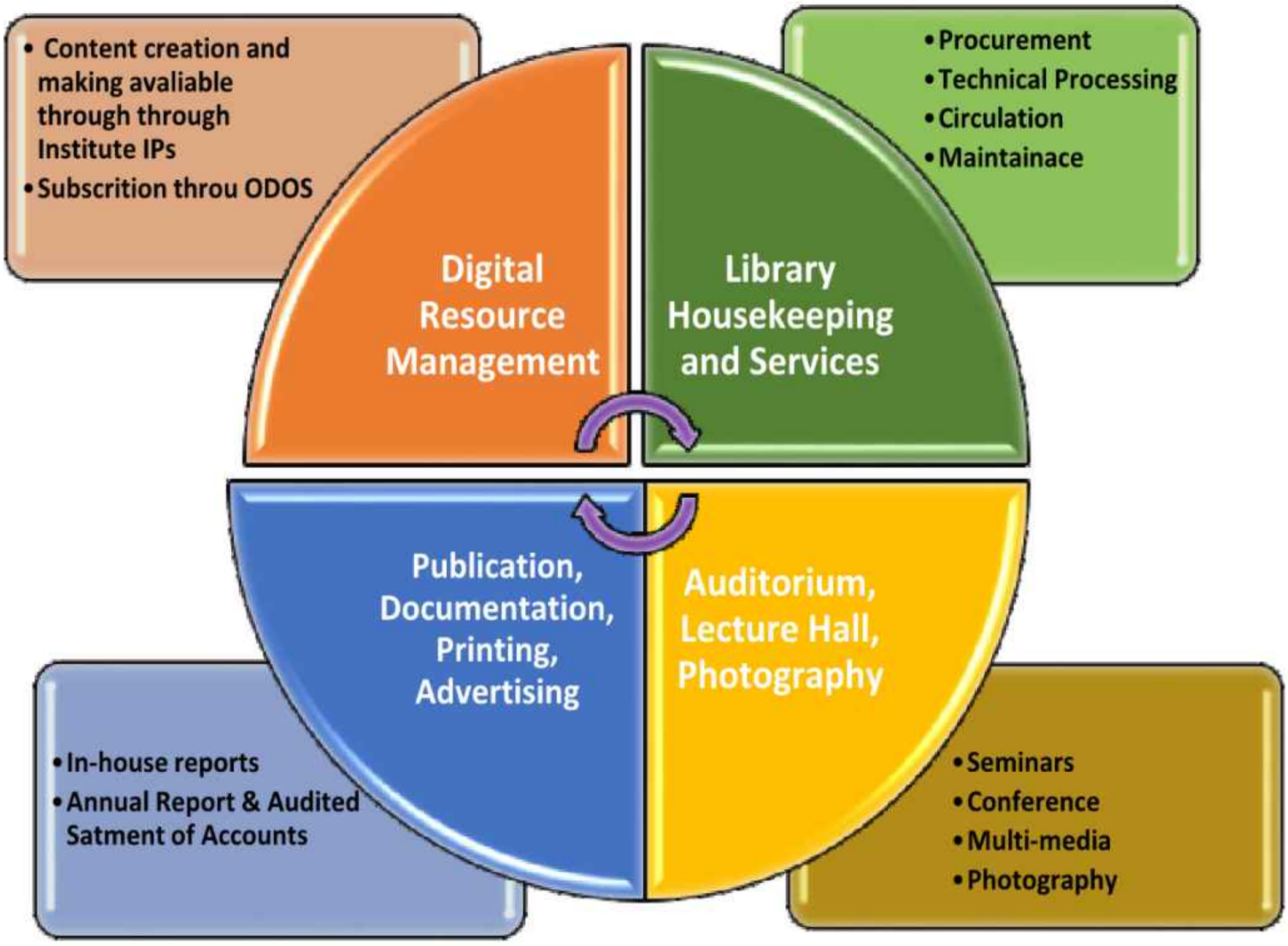
Institute of Physics is a node on ANUNET with the provision to connect other units of DAE directly by VSAT link for voice and data communication. Seismic monitoring equipment has been installed in the Institute and seismic data is being continuously transmitted to Bhabha Atomic Research Centre (BARC) for analysis using ANUNET. The link is also used to connect with DAE and another institute on ANUNET through video conferencing setup.

In addition to members of the Institute, the computer facility is also being used by Researchers from several other universities and colleges in Odisha for their academic work.

5.5. LIBRARY

The primary objective of the IOP Resource Center is to carefully select, acquire, process, and disseminate scientific and technical resources in both print and digital formats to the research community of IOP and its visitors of the institute. However, the IOP General

Library is dedicated to serve the IOP community for the general purpose reading and fostering a culture of reading. Besides its standard library services, the IOP Library provides various additional services, such as reprography, printing, publishing, advertising, photography, videography, document delivery, and an auditorium with lecture hall services. The IOP Library also actively participates in outreach programs and hosts conferences and seminars. A visual representation of the IOP Library's operations is shown in the accompanying figure.



The Library facility is open to both members of the Institute and individuals from other academic institutions, particularly DAE members and those affiliated with the Department of Higher Education of the Government of Odisha. For a comprehensive overview of the Library's holdings, users can visit the Library Portal at http://www.iopb.res.in/~library.

The Library offers a diverse collection that includes over 17,600+ print books, 7,500+ e-books, and 23,643 bound Journals. Subscriptions are being renewed for 135 e-journals, along with selected print Journals, Magazines, and Newspapers. Additionally, the Library has obtained perpetual access rights to electronic archives of publications such as IOP (UK), John Wiley, Springer Physics and Astronomy, Scientific American, World Scientific, and Annual Reviews Archives (OJA). Furthermore, the Library provides access to e-books in the Lecture Notes in Mathematics and Physics series, ensuring perpetual access to back-files.

As a core member of the DAE Consortium, the IOP Library has access to over 500 journals from leading publishers such as Elsevier, Springer-Nature, and Wiley through the ODOS (One DAE One Subscription) initiative. This initiative aims to revolutionize open access research within the DAE, following the model of ONOS (One Nation One Subscription).

The Library has subscribed to iThenticate, an Anti-Plagiarism Web Tool, to uphold the academic integrity of the Institute. This tool is accessible through the library portal at http://www.iopb.res.in/~library/plagiarism.php and can be utilized within the Institute's IP ranges. Additionally, the Library has also subscribed to Grammarly Tool, a cloud-based software service provided by Grammarly Inc., USA, which assists researchers in writing and citation auditing.

As part of the resource sharing program, the Library assists users in obtaining articles from other libraries. Users can also request articles for academic purposes through Digital Inter-Library Loan. Notably, the IOP Library was the first library in Odisha to be automated using the Integrated Library Management System (ILMS). It has then migrated to an RFID-

based Smart Library Solution powered by the KOHA (a widely used Open-source ILMS) in the year 2018. This system supports various library housekeeping activities, including acquisition, cataloguing, circulation, and serial control, with automated check-in and check-out functionalities. To search for books and journals, users can utilize the Library's WEB-OPAC, accessible at https://www.iopb.res.in/~library/ or http://10.0.1.16/.

The Library manages the publication, printing, and advertisement (PRD) division of the Institute, as well as provides reprographic services. To ensure that scientists and the research community at IOP are well-informed about the efficient utilization of e-resources and technology-enabled services, the Library organizes training-cum-demo sessions at regular intervals. Additionally, the Library offers various extension services, including facilitating study tours, inters for Library and Information Science (LIS) students and supporting their projects and dissertations.

5.6 AUDITORIUM:

IOP boasts a splendid auditorium within its campus, purposefully designed for hosting a wide range of events such as Colloquiums, Seminars, Workshops, Conferences, Cultural activities, and Social programs on a regular basis. The auditorium is equipped with top-notch facilities, ensuring a high-quality experience for attendees. It has a seating capacity of over 330 people, providing ample space for gatherings and events.

Chapter 6

PERSONNEL

PERSONNEL

Prof. Karuna Kar Nanda, Director
Institute of Physics

6.1. List of Faculty members and their research specialization

1. **Prof. Shikha Varma**
Professor **(Up to 30.04.2023)**
Condensed Matter Physics
(Experiment)

2. **Prof. Pankaj Agrawal**
Professor **(Up to 30.06.2023)**
High Energy Physics (Theory)

3. **Prof. Biju Raja Sekhar**
Professor
Condensed Matter Physics
(Experiment)

4. **Prof. Sudipta Mukherji**
Professor
High Energy Physics (Theory)

5. **Prof. Suresh Kumar Patra**
Professor
Nuclear Physics (Theory)

6. **Prof. Tapobrata Som**
Professor
Condensed Matter Physics
(Experiment)

7. **Dr. Goutam Tripathy**
Reader-F
Condensed Matter Physics (Theory)

8. **Prof. Pradip Kumar Sahu**
Professor
Nuclear **Physic**s (Theory)

9. **Prof. Dinesh Topwal**
Associate Prof.
Condensed Matter Physics
(Experiment)

10. **Prof. Sanjib Kumar Agarwalla**
Associate Professor
High Energy Physics (Theory)

11. **Prof. Arijit Saha**
Associate Prof.
Condensed Matter Physics (Theory)

12. **Prof. Saptarshi Mandal**
Associate Prof.
Condensed Matter Physics (Theory)

13. **Prof. Satyaprakash Sahoo**
Associate Prof.
Condensed Matter Physics
(Experiment)

14. **Prof. Aruna Kumar Nayak**
Associate Prof.
High Energy Physics (Experiment)

15. **Prof. Debasish Chaudhuri**
Associate Prof.
Condensed Matter Physics (Theory)

16. **Prof. Debakanta Samal**
Associate Prof.
Condensed Matter Physics
(Experiment)

17. **Dr. Debottam Das**
Reader - F
High Energy Physics (Theory)

18. **Dr. Manimala Mitra**
Reader - F
High Energy Physics (Theory)

19. **Dr. Kirtiman Ghosh**
Reader - F
High Energy Physics (Theory)

6.2. Inspire/ Visiting Faculty/Raja Ramanna Fellow

1. Dr. B. K. Panigrahi
2. Dr. Aparajita Mandal
3. Dr. Kuntala Bhattacharjee
4. Dr. Somnath Koley

6.3. Post-Doctoral Fellows

1. Dr. Abhijit Kumar Saha
2. Dr. Bhanu Sharma
3. Dr. Joy Mukherjee
4. Dr. Hemanta Kumar Sharma
5. Dr. Koushik Naskar
6. Dr. Sagarika Swain
7. Dr.Hanuma Kumar
8. Dr. Paramita Maiti
9. Dr. Akavoor Manu

6.4. Doctoral Scholars

1. Alok Kumar
2. Sayari Ghatak
3. Ashish Kumar Panigrahi
4. Rahul Puri
5. Sayak Bhowmik
6. Debabrata Dey
7. Nevin Noble
8. Subhalaxmi Rout
9. Nabendu Mondal
10. Subhransu Sekhar Mishra
11. Aditya Mehta
12. Suman Roy
13. Raju Mandal
14. Sharmistha Chattopadhyay
15. Manish Patel
16. Aswin Kumar Burma
17. Pujalin Biswal
18. Kamalesh Bera
19. Amartya Pal
20. Ithineni Sairam
21. Rameswar Sahu
22. Sanu Varghese
23. Sheikh Moonsun Pervez
24. Subhadip Bisal,
25. Debasish Mondal
26. Dipak Maity
27. Digbijaya Palai,
28. Abhishek Roy
29. Aisha Khatun
30. Ankit Kumar
31. Arnob Kumar Ghosh
32. Arpan Sinha
33. Chitrak Karan
34. Harish Chandra Das
35. Mousam Charan Sahu
36. Pragyanprasu Swain
37. Ritam Kundu
38. Sameer Kumar Mallik
39. Sandhyarani Sahoo
40. Siddharth Prasad Maharathy
41. Sudipta Das

42. Bibhabasu De
43. Diwakar
44. Pranjal Pandey
45. Rupam Mandal
46. Saiyad Ashanujjaman
47. Rojalin Padhan
48. Gupteswar Sabat,
49 Abhisek Bag
50. Avnish
51. Debjyoti Majumdar
52. Subhadip Jana
53. Vinaykrishnan M.B.
54. Sudarshan Saha
55. Alapan Dutta
56. Dilruba Hasina
57. Biswajit Das

6.5. Project Doctoral Fellows

1. Anil Kumar (*INO Proj. Student*)
2. Sadashiv Sahoo (*INO Proj. Student*)

6.6. Administrative Personnel

Prof. Pradip Kumar Sahu (up to July 2023) & Dr. Sachindra Nath Sarangi (from August 2023), Registrar

(i) Director's Office:

1. Bira Kishore Mishra **(Up to 31.05.2023)**
2. Saubhagyalaxmi Das
3. Lipika Sahoo
4. Rajan Biswal
5. Sudhakar Pradhan

(ii) Registrar's Office

1. Abhishek Mahraik
2. Ms. Titili Amrit (From 03.01.2024)
3. Abhimanyu Behera **(Up to 31.05.2023)**

(iii) Establishment

1. M.V. Vanjeeswaran
2. Bhagaban Behera
3. Baula Tudu
4. Rajesh Mohapatra
5. Pramod Kumar Senapati
6. Ranjit Pradhan **(Up to 15.09.2023)**
7. Samarendra Das
8. Pradip Kumar Naik
9. Gandharba Behera **(Up to 31.01.2024)**

(iv) Stores & Transport

1. Purabi Paramita
2. Keshab Chandra Dakua
3. Sarat Chandra Pradhan
4. Jahangir Khan

(v) EPABX

1. Arakhita Sahoo
2. Daitari Das

(vi) Accounts

1. Debendranath Sahoo
2. Priyabrata Patra
3. Raj Kumar Sahoo

4. Purabi Paramita
5. Prativa Choudhury
6. Bijaya Kumar Swain

(vii) Maintenance

1. Arun Kanta Dash
2. Debaraj Bhuyan
3. Brundaban Mohanty
4. Deba Prasad Nanda
5. Naba Kishore Jhankar
6. Martin Pradhan
7. Chandra Mohan Hansdah

(viii) Estate Management

1. Saroj Kumar Jena.
2. Tikan Kumar Parida
3. Bijaya Kumar Das
5. Sanatan Pradhan
6. Bhaskara Mallick
7. Pitabas Barik
9. Kapila Pradhan
10. Dhoba Naik
11. Charan Bhoi
12. Jatindra Nath Bastia
13. Basanta Kumar Naik
14. Ramakanta Nayak
15. Ramesh Kumar Patnaik

(ix) Library

1. Dr. Basudev Mohanty
2. Ajita Kumari Kujur
3. Kisan Kumar Sahoo
4. Kailash Chandra Jena **(Up to 30.09.2023)**

(x) Computer Centre

1. Makrand Siddhabhatti
2. Nageswari Majhi
3. Jyoti Ranjan Behera

(xi) Laboratory

1. Sanjib Kumar Sahu
2. Dr. Sachindra Nath Sarangi
3. Khirod Chandra Patra
4. Madhusudan Majhi
5. Ramarani Dash
6. Santosh Kumar Choudhury
7. Dr. Biswajit Mallick
8. Pratap Kumar Biswal
9. Bala Krushna Dash
10. Soumya Ranjan Mohanty
11. Purna Chandra Marndi
12. Srikanta Mishra
13. Ranjan Kumar Sahoo

(xii) Workshop

1. Subhabrata Tripathy

(xii) Purchase Section

1. Aviram Sahoo
2. Ghanashyam Pradhan

6.7.LIST OF RETIRED MEMBERS

Dr. Mrs. Shikha Verma
Professor
Date of Joining : 10.10.1994
Date of Retirement : 30.04.2023

Sri Birakishore Mishra
Sr. Pvt. Secretary
Date of Joining : 01.04.1991
Date of Retirement : 31.05.2023

Sri Abhimanyu Behera
Tradesman-D
Date of Joining : 05.10.1983
Date of Retirement : 31.05.2023

Dr. Pankaj Agrawal
Professor
Date of Joining : 24.07.1995
Date of Retirement : 30.06.2023

Sri Kailash Chandra Jena
MTS-C
Date of Joining : 15.07.2002
Date of Retirement : 30.09.2023

Sri Gandharba Behera
MTS-C
Date of Joining : 15.07.2002
Date of Retirement : 31.01.2023

RELIEVED FROM INSTITUTE FOR HIGHER ASSIGNMENT

Sri Ranjit Pradhan
Ex-LDC
Date of Joining : 14.12.2021
Date of Relief : 19.09.2023

Sri Raj Kumar Sahoo
Ex-UDC
Date of Joining : 01.05.2015
Date of Relief : 17.01.2024

6.8 NEW MEMBER

Ms. Titli Amrit
Stenographer Gr-III
Date of Joining : 03.01.2024

परीक्षित लेखा विवरण
AUDITED STATEMENT OF ACCOUNTS
2023-24

भौतिकी संस्थान
INSTITUTE OF PHYSICS
भुवनेश्वर, ओडिशा
BHUBANESWAR, ODISHA

जीआरसी एंड एसोसिएट्स / Satapathy & Associates

सनदी लेखाकार / Chartered Accountants

प्लॉट नं.-461/1494, प्राची विहार/ Plot No-461/1494, Prachi Vihar,

पोस्ट ऑफिस: जीजीपी कॉलोनी / PO: GGP Colony

भुवनेश्वर-751025/ Bhubaneswar-751025

CONTENTS

SATAPATHY & ASSOCIATES
Chartered Accountants

Head Office
Plot no. 461/1494,Prachi Vihar
(Back side of Mayur Plaza Apartment
Po- GGP Colony, Palasuni, BBSR- 751025
Mob.: 9861561653,8249130108,94371 83035
E-mail : pksatapathybbsr@gmail.com

INDEPENDENT AUDITORS' REPORT

To

The Director,

Institute of Physics,

Bhubaneswar.

Report on the audit of the financial statements

We have audited the accompanying financial statements of **INSTITUTE OF PHYSICS** ("the Society"), which comprise the balance sheet as at March 31, 2024, and the Statement of Income and Expenditure and the statement Receipt and Payment for the year ended as on that date.

Management's Responsibility for the Financial Statements

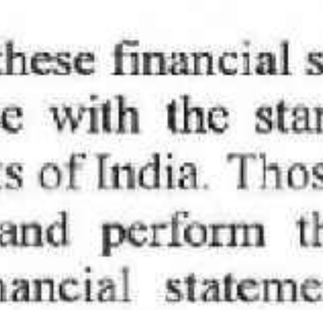
Management is responsible for the preparation of the financial statements that give a true and fair view of the financial position, financial performance of the Society in accordance with the applicable Accounting Standards and Societies Registration Act 1860. This responsibility includes the design, implementation and maintenance of the internal control relevant to the preparation of the financial statements that are free from material misstatement, whether due to fraud or error.

Auditor's responsibility

Our responsibility is to express an opinion on these financial statements based on audit. We conducted our audit in accordance with the standards on auditing issued by the Institute of Chartered Accountants of India. Those standards require that we comply with ethical requirements and perform the audit to obtain reasonable assurance about whether the financial statements are free from material misstatement.

An audit involves performing producing procedures to obtain audit evidence about the amounts and disclosures in the financial statements. The procedures selected depend on the auditor's judgment, including the assessment of the risk of material misstatement of the financial statements, whether due to fraud or error. In making preparation and fair representation of the financial statements in order to design audit procedures that are appropriate in the circumstances. An audit also includes evaluating the appropriateness of accounting polices used and the reasonableness of the accounting estimates made by the management, as well as evaluating the overall presentation of the financial statements.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.



Qualified opinion

Basis of Qualification:

1.

a) The Society has not followed IAS 10 for accounting of fixed assets and AS 6 for provision of depreciation. The society has not maintained fixed assets register to verify the individual asset residual value. Depreciation has been charged on gross block at the end of the year on SLM method irrespective of the fact that individual old assets may have been depreciated in full. The depreciation on assets purchased during the year was also charged for the whole year instead of proportionate basis from date to use.

b) The Fixed Assets of the Society were not physically verified in full during the year under audit.

c) None of the Fixed Assets of the Society were tested for impairment in accordance with IAS 28 and no provision has been made for impairment if any.

2. IAS 12 on accounting of Government grants has not been followed. The grants have been recognized on realization basis. Capital grants have been recognized as capital fund and shown as Liability.

3. The Capital Fund of the Institute is decreased to the tune of Rs97.03 lakhs to due recognition of unutilised Government grant as current liabilities at the end of the year.

Emphasis of Matter:

Attention of the management is also drawn on the following matter:

1. Balances of advances and liabilities to/from third parties are subjects to confirmation.

Based on the above, in our opinion and to the best of our information and according to the explanations given to us, the financial statement read with the Accounting policies and note on accounts gives the information required by the Act in the manner so required and give a True and Fairview in conformity with the Accounting Principles Generally Accepted in India.

a. In the case of Balance sheet of the state of affairs of the Society as at March 31 2024
b. In the case of the statement of income and expenditure, of the deficit of the institute for the year ended on that date.
c. In case of statement of receipt and payments, the receipts and payment for the year ended on the date.

Report on other legal and regulatory requirements

(a) We have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purposes of our audit and have found them to be satisfactory.

(b) In our opinion proper books of account as required by law have been kept by the Institute, so far as it appears from our examination of those books.

(c) The Balance Sheet, the Statement of income and Expenditure and Receipts and payment dealt with by this report are in agreement with the books of accounts.

For Satapathy & Associates
Chartered Accountants
Firm Registration No.324904E

SATAPATHY & ASSOCIATES • Chartered Accountants • Bhubaneswar M. No.059161 FRN-324904E

CA P K Satapathy
Partner
MembershipNo.059161
UDIN: 24059161BKANDT1990

Place: Bhubaneswar
Date: The 30th Day of October 2024

INSTITUTE OF PHYSICS
Sachivalaya Marg, Bhubaneswar

Balance Sheet as at 31st March 2024

SOURCES OF FUNDS	Schedule	Current Year	Previous Year
CORPUS/ CAPITAL FUND AND LIABILITIES			
CORPUS/ CAPITAL FUND	1	48,33,54,953	53,19,82,590
RESERVES AND SURPLUS	2	-	-
EARMARKED/ENDOWMENT FUNDS	3	79,74,860	1,24,40,771
SECURED LOANS AND BORROWINGS	4	-	-
UNSECURED LOANS AND BORROWINGS	5	-	-
DEFFERED CREDIT LIABILITIES	6	-	-
CURRENT LIABILITIES AND PROVISIONS	7	19,92,04,443	20,38,93,435
TOTAL		**69,05,34,256**	**74,83,16,795**

APPLICATION OF FUNDS	Schedule	Current Year	Previous Year
ASSETS			
PROPERTY,PLANT & EQUIPMENTS	8	65,61,73,226	70,36,16,667
INVESTMENTS FROM EARMARKED/ ENDOWMENT FUNDS	9	-	-
INVESTMENTS OTHERS	10	-	-
CURRENT ASSETS, LOANS, ADVANCES ETC.	11	3,43,61,030	4,47,00,128
TOTAL		**69,05,34,256**	**74,83,16,795**
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

As per our attached report of even date

For and on behalf of
Satapathy & Associates
Chartered Accountants
FRN-324904E

CA P K Satapathy
Partner
M.No. 059161
UDIN: 24059161BKANDT1990
Place: Bhubaneswar
Date: The 30th Day of October 2024

For and on behalf of
Institute of Physics, Bubaneswar

(Mr. D. N. Sahoo)
Jr. Accounts Officer
कनिष्ठ लेखा अधिकारी/JUNIOR ACCOUNTS OFFICER
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

(Lt. Col. B. Pattanaik)
Registrar
रेजिस्ट्रार/REGISTRAR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

(Prof. K. K. Nanda)
Director
निदेशक/DIRECTOR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

INSTITUTE OF PHYSICS
Sachivalaya Marg, Bhubaneswar

STATEMENT OF INCOME AND EXPENDITURE FOR THE YEAR ENDED 31ST MARCH 2024

(Amount in Rupees)

Particulars	Schedule	Current Year (2023-24)	Previous Year (2022-23)
INCOME			
Income from sale or services	12		
Grants/ Subsidies	13	38,81,78,035	37,84,01,164
Fees/ Subscriptions	14	-	-
Income from investments	15	-	-
Income from royalty, Publication etc	16	-	-
Interest Earned	17	3,72,236	2,34,731
Other Income	18	10,77,000	13,45,454
Increase decrease in stock of finised goods/ WIP	19	-	-
TOTAL (A)		**38,96,27,270**	**37,99,81,349**
EXPENDITURE			
Establishment Expenses	20	27,78,56,214	27,01,41,379
Other Administrative Expenses etc.	21	9,58,95,486	9,40,35,188
Expenditure on grants Subsidies etc (Plan grant Surrendered)	22	-	-
Interest Paid	23	-	-
Depreciation (Corresponding to Schedule 8)		7,61,31,977	7,49,63,894
TOTAL (B)		**44,98,83,678**	**43,91,40,461**
Balance being excess of Expenditure over Income (A-B)		-6,02,56,407	-5,91,59,112
Unspent Grant at year end		-	71,10,000
BALANCE BEING SURPLUS/(DEFICIT) CARRIED TO CORPUS/ CAPITAL FUND		**-6,02,56,407**	**-6,62,69,112**
SIGNIFICANT ACCOUNTING POLICIES	24		
CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

As per our attached report of even date

For and on behalf of
Satapathy & Associates
Chartered Accountants
FRN\324904E

SATAPATHY & ASSOCIATES Bhubaneswar M. No 059161 FRN-324904E Chartered Accountants

30/10/24

CA P K Satapathy
Partner
M.No. 059161
UDIN: 24059161BKANDT1990
Place: Bhubaneswar
Date: The 30th Day of October 2024

(Mr. D. N. Sahoo)
Jr. Accounts Officer
कनिष्ठ लेखा अधिकारी/JUNIOR ACCOUNTS OFFICER
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

For and on behalf of
Institute of Physics, Bubaneswar

(Lt. Col. B. Pattanaik)
Registrar
रेजिस्ट्रार/REGISTRAR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

(Prof. K. K. Nanda)
Director
निदेशक/DIRECTOR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

INSTITUTE OF PHYSICS, BHUBANESWAR

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2024

SCHEDULE 1 -CORPUS/CAPITAL FUND

(Amount In Rupees)

Particulars	Current Year (2023-24)		Previous Year (2022-23)	
Balances as at the beginning of the year		53,19,82,590		48,25,21,728
Add : Contributions towards Corpus/Capital Fund	1,16,28,771		11,57,29,973	
Add/(Deduct) : Balance of Income/(Expenditure) transferred from Income & expenditure Account	-6,02,56,407	-4,86,27,637	-6,62,69,112	4,94,60,861
Balances as at the year end		48,33,54,953		53,19,82,590

कनिष्ठ लेखा अधिकारी/JUNIOR ACCOUNTS OFFICER
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

रेजिस्ट्रार/REGISTRAR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

निदेशक/DIRECTOR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

For SATAPATHY & ASSOCIATES
Chartered Accountants

P. K. SATAPATHY, FCA, DISA
Partner
M. No.059161
FRN-324904E

INSTITUTE OF PHYSICS, BHUBANESWAR
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2024

SCHEDULE 3 - FARMARKED/ENDOWMENT FUNDS

(Amount in Rupees)

S. No.	Particulars	Current Year (2023-24)				Previous Year (2022-23)
		OB	Receipt	Payment	CB	
1	L.K.Panda Memorial Fellowship SB A/C No.10164207776	1,33,428	3,510	10,000	1,26,938	1,33,428
2	TPSC Account SB A/C No. 450502010004886	1,10,771	3,078	-	1,13,849	1,10,771
3	JC Bose of Prof. A.M.Jayannavar SB A/C No.15987	15,10,708	36,531	14,90,000	57,239	15,10,708
4	JC Bose of Prof. S.M.Bhattacharjee SB A/C No.16376	3,032		3,032	-	3,032
5	CSIR Pool Scientist Programme SB A/C No.18179	8,204		8,204	-	8,204
6	UGC-DAE CSR Grant SB A/C No.18489	2,17,311		2,17,311	-	2,17,311
7	RAMANUJAN FELLOWSHIP DR. A.K. NAYAK SB A/C No.18511	24		24	-	24
8	INSA PROF. J MOHARANA SB A/C No.18532	16,404	87,354	56,200	47,558	16,404
9	BI-IFCC Grant of Dr. P.K. Sahu SB A/C No.18597	6,32,228	20,538	1,68,997	4,83,769	6,32,228
10	Inspire Grant of Dr. Manimala Mitra SB A/C No.18695	1,26,341	3,788	-	1,30,129	1,26,341
11	DST Grant of Prof. S. Verma SB A/C No.18704	31		31	-	31
12	MAX PLANCK GROUP DR. DEBAKANTA SAMAL SB A/C No. 18738	41,54,535	1,15,102	25,65,962	17,03,674	41,54,535
13	INSA YOUNG SCIENTIST SCHEME BY DR. SK AGRAWAL SB A/C No. 18952	3,195	89	-	3,284	3,195
14	NALCO Project - Prof. P.V. Satyam SB A/C No.19051	74,085	2,01,614	-	2,75,699	74,085
15	DST PROJECT OF PROF PANKAJ AGRAWAL SB A/C No. 19123	11,34,310	1,53,426	9,17,807	3,69,929	11,34,310
16	PMFS SB A/C No.19143	3,08,995	1,93,33,811	1,95,63,240	79,566	3,08,995
17	DST PJ TO DR. K BHATTACHARJEE,IIST SB A/C No. 19182	87,201	666	86,900	967	87,201
18	DST PROJECT OF DR. SHAMIK BANERJEE SB A/C No.19296	58,105		58,105	-	58,105
19	IOP PROJECT PRENMM&CE-SERB DR.K. GHOSH SB A/C No. 19314	2,59,965	2,03,963	3,66,270	97,658	2,59,965
20	IOP-PJ-SAP"&F-SERB DR. DEBASISH CHOUDHURI SB A/C No.19315	7,895		7,895	-	7,895
21	SERB PROJECT OF DR. DEBAKANTA SAMAL SB A/C No.19348	21,36,070	56,345	2,46,769	19,45,646	21,36,070
22	IOP INSPIRE FACULTY FELLOWSHIP OF A MANDAL SB A/C No. 19497	4,56,712	5,126	4,41,088	20,750	4,56,712
23	IOP SERB PROJECT OF DR. DINESH TOPWAL SB A/C No.19498	2,68,490	5,326	1,47,880	1,25,936	2,68,490
24	SERB PROJECT OF DR. SATYAPRAKASH SAHOO SB A/C No.19506	2,11,739	4,475	72,842	1,43,372	2,11,739
25	IOP-SERB-LBSMPNE PROJECT OF DR. SK AGARWALLA SB A/C No.19539	23,232	20,29,319	5,37,100	15,15,451	23,232
26	CEFIPRA PROJECT OF DR. MANIMALA MITRA SB A/C No. 19540	3,27,384	6,22,046	4,77,250	4,72,180	3,27,384
27	IOP-PJ-EMHMBOMEST-SAPTARSHI MANDAL SB A/C No.202360	49,447	1,295	3,659	47,083	49,447
28	IOP-PJ-RRF-BINAYA KUMAR PANIGRAHI SB A/C No.20301	1,20,930	12,48,978	12,13,413	1,56,495	1,20,930
29	IOP-PJ-CRS-D-TOPWAL SB A/C No.20780	-	57,506	44,759	12,747	-
30	IOP-PJ-CRS-K.BHATTACHARJEE SB A/C No.20923	-	45,000	59	44,941	-
TOTAL		**1,24,40,771**	**2,42,38,886**	**2,87,04,797**	**79,74,860**	**1,24,40,771**

कनिष्ठ लेखा अधिकारी/JUNIOR ACCOUNTS OFFICER
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

रेजिस्ट्रार/REGISTRAR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

निदेशक/DIRECTOR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

For SATAPATHY & ASSOCIATES
Chartered Accountants

P. K. SATAPATHY, FCA, DISA
Partner
M. No.059161
FRN-324904E

INSTITUTE OF PHYSICS, BHUBANESWAR
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2024

SCHEDULE 7 -CURRENT LIABILITIES AND PROVISIONS:

(Amount in Rupees)

Particulars		Current Year (2023-24)		Previous Year (2022-23)	
A	CURRENT LIABILITIES				
	1 Statutory Liabilities:		-		-
	GST Recovery Payable			-	
	NPS Recovery Payable			-	
	2 Other Liabilities:		3,36,07,480		4,21,56,256
	Earnest money Deposit	1,20,210		99,865	
	Caution money from Scholars	20,600		19,600	
	Audit Fee Payable	59,000		59,000	
	Project Grant Payable	5,18,999		90,000	
	Provision for Expenses	2,07,29,135		2,01,60,069	
	Payable to NALCO Project	68,701		49,875	
	Fellowship Payable	-		85,160	
	Gratuity Payable	5,67,993		6,96,078	
	Security Deposit - contractors	4,92,453		4,19,479	
	Transferable Receipt	17,422		-	
	Unspent Grant	97,03,000		2,03,32,000	
	Incometax Payable	1,45,130		1,45,130	
	GSLI Claim Payable	10,205		-	
	Interest Payable to DAE (NP)	1,25,543		-	
	Interest Payable to DAE (Plan)	10,29,089		-	
TOTAL(A)			**3,36,07,480**		**4,21,56,256**
B	PROVISIONS		16,55,96,963		16,17,37,179
	1 Gratuity	8,36,34,338.00		8,00,64,547	
	2 Accumulated Leave Encashment	8,19,62,625.00		8,16,72,632	
	3 Others (Specify)	0		0	
TOTAL(B)			**16,55,96,963**		**16,17,37,179**
TOTAL(A+B)			**19,92,04,443**		**20,38,93,435**

कनिष्ठ लेखा अधिकारी/JUNIOR ACCOUNTS OFFICER
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

रेजिस्ट्रार/REGISTRAR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

निदेशक/DIRECTOR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

For SATAPATHY & ASSOCIATES
Chartered Accountants

P. K. SATAPATHY, FCA, DISA
Partner
M. No.059161
FRN-324904E

INSTITUTE OF PHYSICS, BHUBANESWAR

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2024

SCHEDULE 8- PROPERTY, PLANT & EQUIPMENTS

(Amount in Rs.)

DESCRIPTION	Rate of Depreciation	GROSS BLOCK				Residual Value	DEPRECIATION				NET BLOCK	
		Cost/valuation as on 01.04.2023	Additions	Deduction	Cost/ valuation as on 31.03.2024		Opening Balance as on 01.04.2023	For the Year	On Deduction	Closing Balance as on 31.03.2024	As on 31.03.2024	As on 01.04.2023
A. PROPERTY,PLANT & EQUIPMENTS (PLAN):												
1 LAND:		-		-	-		-	-	-	-	-	-
a) Leasehold		50,00,000		-	50,00,000		-	-	-	-	50,00,000	50,00,000
2 BUILDINGS:		-		-	-		-	-	-	-	-	-
a) On leasehold Land	1.63%	21,09,86,379		-	21,09,86,379	1,05,49,319	6,39,97,847	34,39,078	-	6,74,36,925	14,35,49,454	14,69,88,532
3 ROADS	1.90%	65,48,158		-	65,48,158	3,27,408	62,20,750		-	62,20,750	3,27,408	3,27,408
4 PLANT MACHINERY & EQUIPMENT	5.28%	90,26,70,701	6,46,16,701	-	96,72,86,902	4,83,64,345	59,82,08,824	5,10,77,748	-	64,92,81,572	31,80,05,330	30,44,61,877
5 COMPUTER/PERIPHERALS	16.21%	15,14,71,345	2,32,391	-	15,17,03,736	75,85,187	14,24,92,738	37,671	-	14,25,30,409	91,73,327	89,78,607
6 Capital Work In Progress		17,79,53,160		5,55,95,587	12,23,57,573	12,23,57,573	-	-	-	-	12,23,57,573	17,79,53,160
7 Advance for capital Goods		2,28,702	-		2,28,702	2,28,702	-			-	2,28,702	2,28,702
TOTAL(A)		1,45,48,57,945	6,48,49,092	5,55,95,587	1,46,41,11,450	18,94,11,534	81,09,20,159	5,45,69,497	-	86,54,89,656	59,86,41,794	64,39,37,286
B. PROPERTY,PLANT & EQUIPMENTS (NON-PLAN)												
1 VEHICLES	9.50%	28,70,817	-	-	28,70,817	1,43,541	27,50,321	-	-	27,50,321	1,20,496	1,20,496
2 FURNITURE, FIXTURES	9.50%	2,40,18,387	13,500	-	2,40,31,887	12,01,594	2,22,53,622	1,283	-	2,22,54,905	17,76,982	17,64,765
3 OFFICE EQUIPMENT	9.50%	13,08,95,733	2,26,123	-	13,11,21,856	65,56,093	12,31,19,005	31,482	-	12,31,50,487	79,81,369	77,76,728
4 ELECTRIC INSTALLATIONS	6.33%	5,11,79,788		-	5,11,79,788	25,58,989	2,46,49,038	32,39,681	-	2,78,88,719	2,32,91,069	2,65,30,750
5 LIBRARY BOOKS	9.50%	46,48,56,494	9,67,264		46,58,23,758	2,32,91,188	44,13,70,352	91,890	-	44,14,62,242	2,43,61,516	2,34,86,142
6 Online Journal Subscription	100.00%	3,05,06,499	1,82,28,144		3,87,34,642	-	2,05,06,499	1,82,28,144	-	3,87,34,643		
TOTAL(B)		69,43,27,718	1,94,35,031	-	71,37,62,748	3,37,51,405	63,46,48,837	2,15,82,480	-	65,62,31,317	5,75,31,432	5,98,78,881
TOTAL OF CURRENT YEAR (A+B)		2,14,91,85,663	8,42,84,123	5,55,95,587	2,17,78,74,198	22,31,63,939	1,44,55,68,996	7,61,51,977	-	1,52,17,00,973	65,61,73,226	70,36,16,667
PREVIOUS YEAR		2,02,54,87,809	12,36,97,854	-	2,14,91,85,663	27,54,56,727	1,37,06,05,102	7,49,63,894	-	1,44,55,68,996	70,36,16,667	65,48,82,707

For SATAPATHY & ASSOCIATES
Chartered Accountants
P. K. SATAPATHY, FCA, DISA
Partner
M. No.059161
FRN-324804E

30/10/24

वरिष्ठ लेखा अधिकारी/SENIOR ACCOUNTS OFFICER
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

रजिस्ट्रार/REGISTRAR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

निदेशक/DIRECTOR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

INSTITUTE OF PHYSICS, BHUBANESWAR
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31ST MARCH 2024

SCHEDULE 11-CURRENT ASSETS, LOANS, ADVANCES ETC.

(Amount in Rupees)

Particulars	Current Year (2023-24)		Previous Year (2022-23)	
A CURRENT ASSETS:				
1 Inventories:		23,20,363		17,20,752
a) Electrical Fittings Stock	9,91,769		10,14,363	
b) Office Stationery	2,54,384		3,61,110	
c) Computer Stationery	6,75,907		87,651	
d) Diesel Stock	1,34,654		40,396	
e) Carpentry Material Stock	34,200		33,389	
f) Workshop Spares	1,68,000		1,64,955	
g) PH Material Stock	21,985		18,888	
h) Cleaning Material stock	44,464			
2 Cash balances in hand (including cheques/ drafts and imprest)	-			
3 Bank Balances:		2,89,78,213		3,45,21,361
a) With Scheduled Banks:				
i) In current accounts SBI	8,04,714.30		9,10,862	
b) Savings accounts				
i) IOB CS Pur (SB-10917)	39,96,369.81		23,27,371	
ii) IOB CS Pur (SB-16916)	1,07,41,583.43		1,67,25,761	
iii) IOP Corpus Fund (SB-19339)	54,60,685.43		21,16,596	
iv) Project Bank Account (Sch.3)	79,74,860.12		1,24,40,771	
TOTAL(A)		3,12,98,576		3,62,42,113
B LOANS, ADVANCES AND OTHER ASSETS				
1 Loans (Interest bearing):		48,000		56,700
a) Computer Advance	48,000.00		56,700	
2 Interest Accrued but not due on Loans		-		4,027
a) Motor Car Advance	0		-	
b) House Buildings Advance	0		4,027	
c) Computer Advance	0		-	
3 Loans (Non-Interest bearing):		3,12,434		1,27,057
a) Staff Advance	1,15,334.00		54,757	
b) Festival Advance			-	
c) Travel Advance	1,47,100.00		33,800	
d) Contingency Advance(ALICE)	50,000.00		38,500	
4 Advances and other amounts recoverable in cash or in kind or for value to be received:		27,02,020		82,70,231
a) On Capital Account				
b) TDS (IT) Receivable	19,626.00		-	
c) Security deposit With CESCO	26,21,944.00		26,21,944	
d) Franking machine deposit	0		2,976	
e) Security Deposit with BSNL	2,000.00		2,000	
f) Security Deposit for GAS	20,950.00		20,950	
g) STDR against LC	0		55,84,861	
h) AKRUTI Fund Receivable	37,500.00		37,500	
TOTAL(B)		30,62,454		84,58,015
TOTAL(A+B)		3,43,61,030		4,47,00,128

30/10/24

कनिष्ठ लेखा अधिकारी/JUNIOR ACCOUNTS OFFICER
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

रजिस्ट्रार/REGISTRAR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

निदेशक/DIRECTOR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

For SATAPATHY & ASSOCIATES
Chartered Accountants

P. K. SATAPATHY, FCA, DISA
Partner
M. No 058161
FRN-324904E

INSTITUTE OF PHYSICS, BHUBANESWAR
SCHEDULES FORMING PART OF STATEMENT OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31ST MARCH 2024

SCHEDULE 13 -GRANTS/ SUBSIDIES

(Amount in Rupees)

Particulars	Current Year (2023-24)		Previous Year (2022-23)	
1 DAE - Government of India		38,81,78,035		37,84,01,164
a) Revenue (Salary)	27,26,45,338		26,81,00,000	
b) Revenue (General)	7,15,27,429		6,83,30,992	
c) Creation of Capital Assets	4,06,82,576		4,19,70,172	
d) GIA-ALICE	20,33,434		-	
e) GIA-CMS	12,89,258		-	
2 Government Of Orissa (Non-Plan Revenue)	-			-
TOTAL		**38,81,78,035**		**37,84,01,164**

INSTITUTE OF PHYSICS, BHUBANESWAR
SCHEDULES FORMING PART OF STATEMENT OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31ST MARCH 2024

SCHEDULE 17 - INTEREST EARNED

(Amount in Rupees)

Particulars	Current Year (2023-24)		Previous Year (2022-23)	
1 On Term Deposits:		3,57,238		2,24,927
a) With Scheduled Banks				
b) Others (LC & Security Deposit)	3,57,238		2,24,927	
2 On Savings Accounts:		-		-
a) With Scheduled Banks				
3 On Loans:		14,998		9,804
a) Computer Advance	5,941.00		9,677	
b) Motor Car Advance	0		127	
c) Pending Advances	9,057.00		-	
TOTAL		**3,72,236**		**2,34,731**

30/10/24
कनिष्ठ लेखा अधिकारी / JUNIOR ACCOUNTS OFFICER
भौतिकी संस्थान / INSTITUTE OF PHYSICS
भुवनेश्वर / BHUBANESWAR

रेजिस्ट्रार / REGISTRAR
भौतिकी संस्थान / INSTITUTE OF PHYSICS
भुवनेश्वर / BHUBANESWAR

निदेशक / DIRECTOR
भौतिकी संस्थान / INSTITUTE OF PHYSICS
भुवनेश्वर / BHUBANESWAR

For SATAPATHY & ASSOCIATES
Chartered Accountants

P. K. SATAPATHY, FCA, DISA
Partner
M. No.059161
FRN-324904E

INSTITUTE OF PHYSICS, BHUBANESWAR

SCHEDULES FORMING PART OF STATEMENT OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31ST MARCH 2024

SCHEDULE 18- OTHER INCOME

(Amount in Rupees)

Particulars	Current Year (2023-24)		Previous Year (2022-23)	
Other Income				
1 Miscellaneous Income		27,741		99,475
a) Project Overhead				-
b) I-Card Charge				
c) RTI Fee	1,526.00		330	
d) Auditorium Charges	25,000.00		88,000	
e) Miscellaneous Income	1,215		7,040	
f) Interest on IT Refund			4,105	
2 Sale of Tender paper		2,700		10,500
3 Rent				
a) Bank Premises Rent	3,60,000.00	10,46,559	3,60,000	12,35,479
b) Guest House Rent	5,53,630.00		5,52,790	
c) Hostel Room Rent	1,32,929.00		3,22,689	
TOTAL		**10,77,000**		**13,45,454**

कनिष्ठ लेखा अधिकारी/JUNIOR ACCOUNTS OFFICER
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

रेजिस्ट्रार/REGISTRAR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

निदेशक/DIRECTOR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

For SATAPATHY & ASSOCIATES
Chartered Accountants

P. K. SATAPATHY, FCA, DISA
Partner
M. No.059161
FRN-324904E

INSTITUTE OF PHYSICS, BHUBANESWAR

SCHEDULES FORMING PART OF STATEMENT OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31ST MARCH 2024

SCHEDULE 20 - ESTABLISHMENT EXPENSES

(Amount in Rupees)

Particulars	Current Year (2023-24)		Previous Year (2022-23)	
1 Salaries and Wages		15,98,48,367		15,93,46,997
a) Staff Salary	12,37,06,252		12,77,22,309	
b) NPS Contribution	61,33,770		65,78,643	
c) Honorarium	9,29,178		3,48,283	
d) Fellowship	2,84,07,339.00		2,41,68,031	
e) Remuneration to Medical Officer	6,71,828.00		5,29,731	
2 Allowances and Bonus		1,34,01,229		2,91,36,650
a) PRIS	1,13,14,621.00		2,56,01,061	
b) Update Allowance	19,61,608.00		33,95,589	
c) Uniform Allowance	1,25,000.00		1,40,000	
3 Staff Welfare Expenses		1,07,32,129		34,19,010
a) Reimbursement of Medical Expenses	78,10,748.00		17,58,947	
b) Canteen Expense	10,48,625.00		1,52,591	
c) Recreation & Welfare Expenses	6,56,236.00		1,28,982	
d) Children Education Allowance	12,15,000.00		13,77,000	
e) Medical Aid Centre Expenses	1,520.00		1,490	
4 Retirement and Terminal Benefits		9,17,99,247		7,61,41,924
a) Leave salary	99,90,635.00		1,03,01,005	
b) Pension	6,95,07,637.00		5,67,25,465	
c) Gratuity	1,23,00,975.00		91,15,454	
5 Others		20,75,242		20,96,798
a) Contigency Grant to Scholars	20,75,242.00		20,96,798	
TOTAL		**27,78,56,214**		**27,01,41,379**

20/10/24

कनिष्ठ लेखा अधिकारी/JUNIOR ACCOUNTS OFFICER
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

रेजिस्ट्रार/REGISTRAR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

निदेशक/DIRECTOR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

For SATAPATHY & ASSOCIATES
Chartered Accountants

P. K. SATAPATHY, FCA, DISA
Partner
M. No 058161
FRN-324804E

INSTITUTE OF PHYSICS, BHUBANESWAR
SCHEDULES FORMING PART OF STATEMENT OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31ST MARCH 2024

SCHEDULE 21 -OTHER ADMINISTRATIVE EXPENSES ETC.

(Amount in Rupees)

Particulars	Current Year (2023-24)		Previous Year (2022-23)	
1 Repair & Maintenance		2,30,78,796		1,82,60,888
a) Civil	1,24,57,792.00		83,20,348	
b) Vehicle	4,25,639.00		5,80,410	
c) Library	7,23,638.00		7,32,758	
d) Workshop	7,230.00		24,467	
e) Furniture	14,050.00		55,674	
f) Electrical	9,17,489.00		6,78,568	
g) AC Plant	41,89,405.00		10,56,645	
h) Computer	6,06,177.00		39,71,370	
i) Laboratory	28,31,085.00		24,88,589	
j) Garden	3,96,299.00		1,58,005	
k) Telephone	2,75,832.00		-	
l) Office Equipment	2,34,160.00		1,94,054	
2 Electricity and power		1,70,73,520.68		2,06,12,314
3 Water charges		1,53,526.00		3,41,230
4 Conference & Symposia		3,46,273.00		4,73,409
5 Science Outreach Activities		7,16,793.00		10,72,527
6 Postage & Telegram		48,358.00		45,655
7 Telephone & Telex		5,35,528.00		8,45,826
8 Printing and Stationery		7,31,570.00		3,37,328
9 Travelling Expenses		13,08,370		18,05,827
a) Conference TA	88,915		2,15,067	
b) Foreign Travel	-		3,300	
c) Visiting scientist TA	77,893		1,17,542	
d) Domestic Travel	8,75,733		3,25,917	
e) Leave Travel concession	2,33,076		11,25,773	
f) Hire Charge	32,753		16,228	
10 Auditors Remuneration		59,000.00		59,000
11 Entertainment Expenses		5,40,960.00		4,79,451
12 Security Charges		64,07,596.00		66,70,820
13 Professional Charges		1,54,455.00		1,02,030
14 Project Revenue Expenses		4,40,64,171		4,22,40,477
a) ALICE Utilisation and CBM Participation	20,33,434		2,86,732	
b) Investigating Spin Structure	58,903		2,69,780	
c) Vigyan Prativa	-		525	
d) CMS_Revenue Expenses	12,89,258		10,532	
e) Supporting Scientific Infr. (RID 4003)	1,56,07,220		2,95,82,457	
f) Theoretical and Experimental Physics	2,50,75,356		1,20,90,451	
15 Advertisement and Publicity		2,78,954		2,81,885
16 AKRUTI Expenditure		-		-
17 Books & Journal		-		-
a) Books	-		-	
b) Online Journal Subscription	-		-	
18 Lease Rent		-	-	-
19 Priorperiod Expenses		-	-	-
20 Interest on Income Tax		-	-	-
21 Others		3,97,616.00		4,06,521.20
a) Miscellaneous Expenses	3,97,616		4,06,521	
TOTAL		9,58,95,486		9,40,35,188

कनिष्ठ लेखा अधिकारी/JUNIOR ACCOUNTS OFFICER
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

रजिस्ट्रार/REGISTRAR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

निदेशक/DIRECTOR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

For SATAPATHY & ASSOCIATES
Chartered Accountants

P. K. SATAPATHY, FCA, DISA
Partner
M. No.05[illegible]

INSTITUTE OF PHYSICS
BHUBANESWAR

SCHEDULES FORMING PART OF THE ACCOUNTS

FOR THE YEAR ENDED ON 31.03.2024

SCHEDULE 24 - SIGNIFICANT ACCOUNTING POLICIES

1. **ACCOUNTING CONVENTION**

The financial statements have been prepared under accrual basis under historical cost convention with Generally Accepted Accounting Principles in India except for Government Grants.

2 **PROPERTY, PLANT & EQUIPMENTS**

2.1 Freehold: Property, Plant & Equipment are stated at Historical cost less accumulated Depreciation. The cost of acquisition includes the cost of Carriage Inward, duties & taxes and other incidental direct expenses incurred in relation to such particular fixed assets.

2.2 Leasehold: Out of acquired leasehold land of Ac. 56.130 dec., the institute is in possession of title of land of Ac.6.130 dec. . The Lease rent has been paid on A6.130 dec land upto 31.03.2024. Rest of the land is in the name of Higher Education Department, Govt. of Odisha, alienated in favour of the Institute and hence for this part, no rent is due to the State Government.

3. **INVESTMENT**

Noncurrent Investments are carried individually at cost less Provision for diminution. Current Investments are carried at lower of Cost of fair value.

However, the Institute has no long-term Investment of any nature. Moreover, there are short-term investments in shape of STDR with bank.

4. **VALUATION OF INVENTORIES**

Stock of Office Stationery, Computer Stationery, Cleaning Material Stock, Hardware and Electrical items etc. are valued at cost.

5. **BANK BALANCE**

Earmarked/ Endowment Fund (As per Sch-3) Bank balances of ₹ 0.80 Crore shown under the total Bank balances.

6. **DEPRECIATION**

6.1 Depreciation is provided on straight-line method at the rates specified in the Company Act, 1956. However, the amendment of 2013 has not been taken into account. Depreciation has been charged on those assets whose WDV are exceeding the residual value of 5% of Gross Block as per the fixed assets schedule. However incase of addition of Fixed Assets, depreciation has not been calculated on the basis of number days put to use.

6.2 Assets costing ₹ 5000/- or less are fully provided.

30/10/24

कनिष्ठ लेखा अधिकारी/JUNIOR ACCOUNTS OFFICER
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

रजिस्ट्रार/REGISTRAR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

निदेशक/DIRECTOR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

For SATAPATHY & ASSOCIATES
Chartered Accountants

P. K. SATAPATHY FCA, DISA
Partner
M. No.059161
FRN-324904E

7. **GOVERNMENT GRANTS / SUBSIDIES**

The grants are accounted for on realisation basis.

7.1. Plan grants to be utilised for capital expenditure is treated as Capital Fund otherwise has been taken into Income & Expenditure A/c.

7.2. Non-Plan grants to be utilised for revenue expenditure has been taken into Income & Expenditure A/c.

7.3. The Grants received, unutilized at the yearend has been considered as current Liability.

8. **FOREIGN CURRENCY TRANSACTIONS**

Transactions involving foreign currency are accounted at the exchange rate prevailing on the date of the transactions.

9. **RETIREMENT BENEFITS**

9.1 Liability in respect of Gratuity on retirement payable as on 31.03.2024 has been provided in accounts on actual basis. Provision for liability towards accumulated leave encashment benefit to the employees as on 31.03.2024 has been provided for in accounts on actual valuation.

9.2 Provision for liability payable towards Pension to the employees has been provided in the Accounts.

9.3 No Pension fund has been created by the Institute.

9.4 Contribution to newly defined pension scheme has been made regularly by the Institute for those employees who have joined the Institute after 01-01-2004.

9.5 The Institute has its own Provident Fund Trust which manages the Provident Fund of the employees who have joined the Institute on or before 31.12.2003. The Accounts of the Trust for the year ending 31.03.2024 has been audited by a firm of Chartered Accountants.

20/10/24

कनिष्ठ लेखा अधिकारी/JUNIOR ACCOUNTS OFFICER
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

रेजिस्ट्रार/REGISTRAR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

निदेशक/DIRECTOR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

For SATAPATHY & ASSOCIATES
Chartered Accountants

P. K. SATAPATHY, FCA, DISA
Partner
M. No.059161
FRN-324904E

INSTITUTE OF PHYSICS
BHUBANESWAR

SCHEDULES FORMING PART OF THE ACCOUNTS

FOR THE YEAR ENDED ON 31.03.2024

SCHEDULE 25 – CONTIGENT LIABILITIES AND NOTES ON ACCOUNTS

1. CONTIGENT LIABILITIES

1.1.	Bank Guarantee given by / on behalf of the Institute	NIL
1.2.	Bills discounted with Bank	NIL
1.3.	Letter of Credit	Nill
1.4.	Disputed demand in respect of	
	Income Tax	NIL
	Sales Tax/GST (IDS)	NIL
	Municipal Taxes	NIL
1.5.	In respect of claims from parties for non-execution of orders	NIL

2. NOTES ON ACCOUNTS

2.1. **CURRENT ASSETS. LOANS AND ADVANCES**

The current assets, loans and advances have a value on realization in the ordinary course of business, equal at least to the aggregate amount shown in the Balance Sheet.

2.2. **CURRENT LIABILITIES & PROVISIONS**

All known liabilities have been provided in the accounts of the Institute.

2.3. **TAXATION**

The Institute is a research-oriented organization founded by Government of India, Department of Atomic Energy jointly with Government of Odisha. The income of the Institute is exempted under Income-tax Act 1961 and hence no provision for Income tax has been made during the year.

2.4. External Grants from DST & other funding agencies for specific projects/fellowship have been taken into account in the year under Earmarked Fund.

2.5. Figures in the Balance Sheet and Income & Expenditure Account have been rounded off to nearest rupee.

2.6. Previous year's comparative figures have been regrouped/ rearranged, wherever necessary. Figures in the brackets indicate (-ve).

2.7. Income recognition on interest on staff Loan is accounted after the repayment of principal as per practice adopted. Interest on saving bank is accounted on receipt basis.

2.8. Schedule 1 to 25 are annexed to and form an integral part of the Balance Sheet as at 31.03.2024 and Income & Expenditure Account for the year ended on that date.

कनिष्ठ लेखा अधिकारी/JUNIOR ACCOUNTS OFFICER
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

रजिस्ट्रार/REGISTRAR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

निदेशक/DIRECTOR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

For SATAPATHY & ASSOCIATES
Chartered Accountants

P. K. SATAPATHY, FCA, DISA
Partner
M. No.059161
FRN-324904E

3 FOREIGN CURRENCY TRANSACTIONS

Value of Imports calculated on C.I.F/Ex-works & FOB basis	31.03.2024 (₹)	31.03.2023 (₹)
a) Purchase of Lab. Equipment	Nil	Nil
b) Stores, Spares and Consumables	97,45,276	55,84,861
c) Journal subscription	82,62,360	3,94,55,846
Expenditure in foreign currency		
a) Travel	Nil	Nil
b) Other expenditure (Honorarium)	2,73,331	1,33,197
Earnings		
Value of Exports on FOB basis	Nil	Nil

4 Remuneration to Auditors

As Audit Fees	50,000	50,000

30/10/24

कनिष्ठ लेखा अधिकारी/JUNIOR ACCOUNTS OFFICER
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

रेजिस्ट्रार/REGISTRAR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

निदेशक/DIRECTOR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

For SATAPATHY & ASSOCIATES
Chartered Accountants

P. K. SATAPATHY, FCA, DISA
Partner
M. No.059161
FRN-324904E

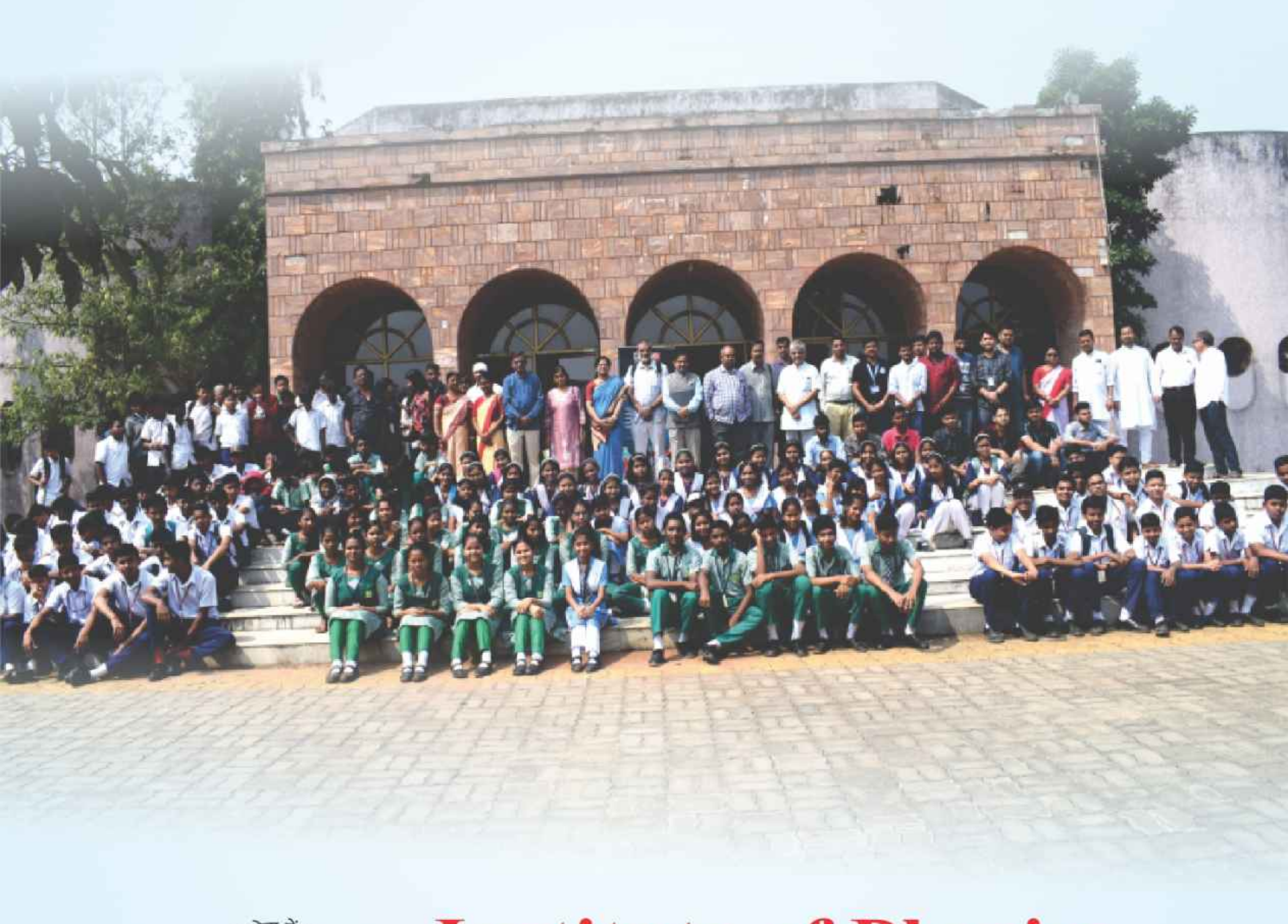
ACTION TAKEN REPORT ON THE COMMENTS OF STATUTORY AUDITORS ON THE ANNUAL ACCOUNTS OF INSTITUTE OF PHYSICS, BHUBANESWAR FOR THE FINANCIAL YEAR 2023-24

Sl. No.	AUDITOR'S OBSERVATION	INSTITUTE'S REPLY
Qualified opinion		
Basis of qualification		
1	a) The Society has not followed IAS 10 for accounting of Fixed Assets and AS 6 for provision of depreciation. The society has not maintained fixed assets register to verify the individual asset residual value. Depreciation has been charged on gross block at the end of the year on SLM method irrespective of the fact that individual old assets may have been depreciated in full. The depreciation on assets purchased during the year was also charged for the whole year instead of proportionate basis from date to use.	Noted for corrective measures. The Institute has engaged M/s. Laldash& Co., CAs vide W.O. No. 793 dt.25.06.2018 for preparation of Asset Register from 2011-12 onwards and they have submitted their report year wise up to 2020-21. The current year Assets Register has been prepared by the Institute.
	b) The Fixed Assets of the Society were not physically verified in full during the year under audit.	The institute is doing the physical verification of Fixed Assets on yearly basis. The assignment of physical verification is in full swing by M/s. Laldash & Co., CAs. along with the internal team to be completed soon
	c) None of the Fixed Assets of the Society were tested for impairment in accordance with IAS 28 and no provision has been made for impairment if any.	Point has been noted for future compliance.
2	IAS 12 on accounting of Government grants has not been followed. The grants have been recognized on realization basis. Capital grants have been recognized as capital fund and shown as Liability.	The Institute has been receiving full grant from DAE (Govt. of India) under GIA (General) and GIA (Creation of Capital Assets) which is treated as Capital Fund as per the provision of Accounting Standard 12.
3	The Capital Fund of the Institute is decreased to the tune of Rs97.03 lakhs to due recognition of unutilised Government grant as current liabilities at the end of the year.	No comments
Matter of emphasis		
1	Balances of advances and liabilities to/from third parties are subjects to confirmation.	Point has been noted for future compliance.

कनिष्ठ लेखा अधिकारी/JUNIOR ACCOUNTS OFFICER
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

रेजिस्ट्रार/REGISTRAR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR

निदेशक/DIRECTOR
भौतिकी संस्थान/INSTITUTE OF PHYSICS
भुवनेश्वर/BHUBANESWAR



राष्ट्र की सेवा में परमाणु
भौ सं
IOP
ATOMS IN THE SERVICE OF THE NATION

भौतिकी संस्थान
Institute of Physics

Institute of Physics

Sachivalaya Marg, P.O. : Sainik School
Bhubaneswar - 751005, Odisha, India
Phone : +91-674-2306400 / 444 / 555
Fax : +91-674-2300142
URL:http://www.iopb.res.in