



MANIPAL
ACADEMY of HIGHER EDUCATION
(Institution of Eminence Deemed to be University)

Newsletter

VOLUME 2/ISSUE 1 & 2

ನಿಸರ್ಗ NISARGA

Manipal Centre for Natural Sciences



BY MR. HOWARD ONG, THE PRINCIPAL

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EDITOR'S VOICE

Dr. V. Gopalakrishnan
Editor - Nisarga



This issue of Nisarga is a combined issue covering both the halves of 2023. It comes with a new look, along with certain reader-friendly features like page-flipping. As you see on turning the pages of this issue, 2023 had been very significant to MCNS in terms of the number of faculty addition, the number of successful PhD students, the number of students admitted, the number of globally significant events with our contribution, the number of international meetings, etc., amidst regular research activities. MCNS makes MAHE proud through its technologically crucial participation in the Aditya-L1 mission of India. The number of eager applicants for the Summer Research Internship program indicates the visibility of the Centre within the country, while the number of eminent participants in the International Symposium on Nuclear Astrophysics (ISNA - 2023), as well as in the Regional Astronomy Meet, shows its international visibility. The issue brings two interesting scientific articles one in chemistry and another in astrophysics, both topics being close to the research fields pursued in the Centre.

MCNS owes all its recent progress to its new Director, Dr. P. Sreekumar, whose brief writeup herein, under 'Director Speaks', describes his commitment to taking the Centre to a plane of global respect. I give below an abridged version of his curriculum vitae:

Dr. P Sreekumar, an eminent astrophysicist, took over as the Director of our Centre, effective April 01, 2023. He joined MCNS from the Indian Space Research Organization - Head Quarters (ISRO HQ), Bengaluru, where he served as the Satish Dhawan Professor and advisor to the Space Science Program office at ISRO HQ from 2020. Prior to this, he served as the Director of Space Science Program, ISRO HQ from 2018-2020. He also served as the Visiting Scientist at Raman Research Centre from 2001 to 2013. Dr. Sreekumar has been the Principal Investigator of payloads of prestigious Lunar Missions (Chandrayaan 1 & 2). He is the Co-PI of India's first dedicated astronomy observatory, AstroSat Mission. He was also a core team member of EGRET on NASA's Compton Gamma Ray Observatory. Among his many honours Dr. Sreekumar is a recipient of ASI Zubin Kumbhavi Award 2022 instituted by the Astronomical Society of India (ASI).

Nisarga comes to you not just to present the path of growth of MCNS during the period, but to welcome your encouragement, interaction and collaboration wherever feasible, to help the Centre scale new heights in scientific understanding towards making India stronger and self-reliant.

DIRECTOR SPEAKS

Prof. Sreekumar
Director, MCNS



It is a special honor for me to become part of the Manipal Centre for Natural Sciences family in 2023. MCNS specializes in areas of Astronomy & Astrophysics, Nuclear and Particle Physics, Computational Chemistry and Evolutionary Biology. It is one of the largest astronomy research groups in the University sector in India with research areas extending from the study of inflation in the early Universe, formation and evolution of galaxies and galaxy clusters, birth, evolution and death of stars, dust in the Universe, cosmic sources of strong gravity and magnetic fields, to our own solar system, Sun and its influence on Earth.

As an identified Center of Excellence in science research, MCNS has grown rapidly in the past two years with the addition of many new faculties, students and academic programs. The rapid increase in students under the Integrated MSc- Ph.D program in Physics and the induction of many Ph.D scholars in 2023, has made MCNS a vibrant place of research. With many new research investigations underway, 2024 appears to be a year when MCNS also will contribute most towards the "Year of Research Excellence".

As a new member of the MAHE family, I am truly impressed by the wide spectrum of ongoing activities at MAHE, the efficient management, the good student pool, and numerous resources, not typically available at most large Universities in India. It offers an excellent ecosystem to explore interdisciplinary research; we have initiated a few programs with a desire to enhance the contribution of MCNS research to the overall MAHE goals.

2023 has been of special importance to MCNS with the completion and delivery of an important space experiment, the Solar Ultraviolet Imaging Telescope (SUIT) - led by the Inter-University Center for Astronomy and Astrophysics (IUCAA) and developed jointly with MCNS. MCNS faculties have contributed much to the development, testing, and calibration of this space payload and also been integral part of many senior-level technical reviews of the Aditya-L1, Chandrayaan-3 and Xposat missions. Every day, the Payload Operations Center at MCNS, provides the identification of the region of interest on the Sun, for focused studies by SUIT. Since the last edition of NISARGA, we also organized two large conferences of about 100 delegates each - an international conference on Nuclear Astrophysics and a successful Regional Astronomy Meet. The 2024 calendar includes a special international conference on Astrostatistics, at MCNS, MAHE.

As MCNS continues its sustained success in attracting good students into our academic and research programs, it imposes a greater demand on all faculties to take up more and more challenging research programs, expand their core areas of work and take up new collaborations nationally and internationally. Currently, we have initiated a set of computer-based simulation programs for optimizing space payload design, safety of humans inside crew modules with recommendations on suitable space-qualified materials for shielding and also to simulate changes in astrophysical signatures from cosmic systems embedded in different physical and chemical environments. We are considering improving the hands-on experience for students on experimental programs with an enhanced laboratory, which we hope will form the start of a full fledged research lab for experimental astronomy in future. I look forward to working closely with my colleagues at MCNS and at other centers of MAHE and with the good support of the management, translate some of the new initiatives into programs on a firm footing.

SCIENTIFIC ARTICLE 1 - ORGANIC MAGNET

Dr. Suranjan Shil

Assistant Professor, MCNS

Introduction

Magnetism plays an important role in our modern lifestyle, from medical scanners to MRAM. Traditional magnets are made of metal-based complexes. However, metal-based magnets have several drawbacks, such as a short life time. On the other hand, organic magnets can maintain magnetization for longer times due to negligible spin-orbit coupling. In metal-based magnets, unpaired spins on metal atoms are responsible for magnetic behaviour; however, in organic molecules, there are no unpaired electrons in natural covalent bonding. To make an organic magnet, we need to break the bond between two atoms and make an unpaired electron that could be stable. Such radicals, when present in organic molecular crystals, may behave like magnets. The commonly used organic radicals used for making organic magnets are nitronyl nitroxide, imino-nitroxide, Verdazyl, TEMPO, etc. (Figure 1)

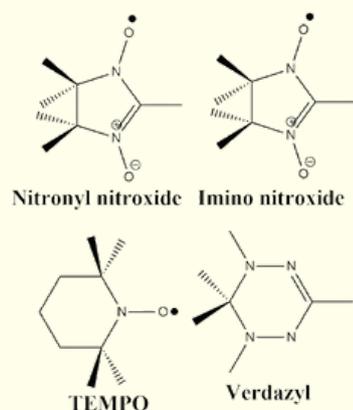


Figure 1. The chemical structure of stable radicals

Design of the organic magnet

To make an organic ferromagnet, we need at least two radicals attached via a coupler moiety, as in scheme 1. The nature of the intramolecular magnetic interaction in an organic diradical magnet depends on the connecting bond between the radical and the coupler. For example, if the coupler is benzene, then the meta-connected diradical will be a ferromagnet, and the para-connected diradical will be an antiferromagnet (Figure 2).



Scheme 1. The typical design of an organic magnet

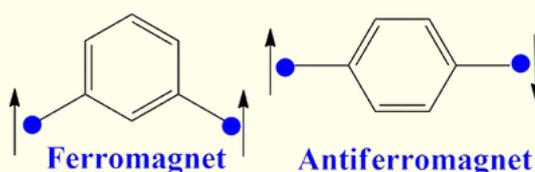


Figure 2. Ferromagnetic and anti-ferromagnetic interactions in organic diradical magnets

Quantification of magnetism

The magnetic property of an organic magnet can be quantified with the isotropic Heisenberg spin Hamiltonian as $H = -2J\mathbf{S}_a \cdot \mathbf{S}_b$, where J is the magnetic exchange coupling constant between magnetic sites a and b , and S_a and S_b are the respective spin angular momentum operators. A positive value of J refers to ferromagnetic coupling, and a negative J represents antiferromagnetic coupling. J can be calculated as the energy difference between the high spin and low spin states of the molecule.

Mechanism of magnetic coupling

Itinerant exchange is the main interaction mechanism in organic radical-based magnets, as shown in Figure 3. In the itinerant exchange mechanism, the radical electrons interact with each other through the coupler's p bond. In addition to itinerant exchange, it is also possible to obtain direct exchange between radicals when they are spatially close to each other.

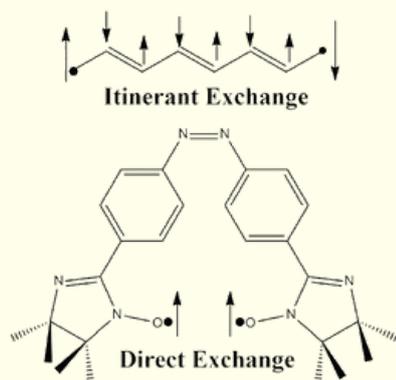


Figure 3. Different exchange mechanisms

Strength of magnetic interaction in an organic magnet

The strength of the magnetic interaction depends on various factors, such as the distance between the radical centers, the coupler's electronic structure, the planarity of the radicals and coupler (Figure 4) which affects the spin polarization between radicals through coupler (Figure 5), and the electronic structure of the diradical. When the distance between the radical centres increases, the coupling constant decreases, except for the cumulene

coupler, where the coupling strength increases with the distance between the radicals. The HOMO-LUMO gap of the molecule also plays a vital role in coupling strength, such as with a smaller HOMO-LUMO gap, the coupling is high. The diradical character of the coupler is also associated with the coupling strength, and a high diradical character coupler gives stronger coupling between the radicals. The planarity of the radical and the coupler is also an important parameter for the coupling strength, when the coupler and the radicals are in the same plane, and the diradical produces strong coupling due to easy itinerant exchange.

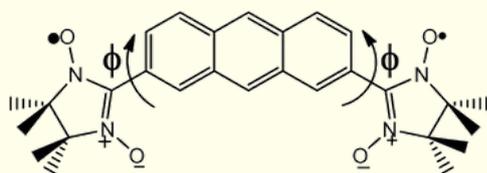


Figure 4. Representation of the dihedral angle (ϕ) between the radical and the polyacene. (reprinted from RSC Adv., 2015, 5, 105574-105582)

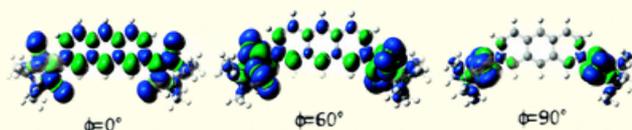


Figure 5. Spin density plot of the diradical at different radical-coupler dihedral angles (ϕ). (reprinted from RSC Adv., 2015, 5, 105574-105582)

Conclusion

Organic magnets have tremendous potential for application in future technology. The main challenge is in obtaining a desired organic magnet with high magnetic exchange coupling, and stability at high temperatures. Study towards the understanding of the science behind magnetic behavior and the computational design of organic magnets are ongoing in MCNS. We hope that in the near future, we will develop some good candidates for organic magnets that can be synthesized by synthetic chemists.

SCIENTIFIC ARTICLE 2 - MULTIWAVELENGTH STUDY OF RADIO GALAXY PICTOR: A POSSIBLE ORIGIN OF HIGH ENERGY EMISSIONS

Dr. Debbijoy Bhattacharya

Associate Professor, MCNS

Active galaxies are one of the most luminous objects in the universe. A tiny region at the centre of an active galaxy (Active Galactic Nuclei: AGN) can outshine the rest of the galaxy. AGN are powered by the accretion of matter onto the central supermassive black holes (SMBH) of million to billion solar mass. They also harbour astrophysical jets of relativistic particles that emit from radio to very high energy gamma-rays and can extend to a large distance much beyond the extent of the host galaxies. The particle acceleration and emission processes in astrophysical jets around supermassive black holes in active galaxies are still debatable even after more than 70 years of their discovery. Active galaxies whose jets make a large angle to the line-of-sight are called “Misaligned active galaxies”. Due to the large jet inclination angle, their jets can be resolved in multi-wavelength and therefore, they provide an excellent laboratory to study physical processes in jets.

We carried out a comprehensive study of the nucleus and western hotspot of the jet of the active galaxy Pictor A using AstroSat observations, 13 years of Fermi gamma-ray space telescope, and archival Swift observations along with other published data. We report the first detection of the western hotspot of Pictor A in the far-UV band using observations from AstroSat-UVIT. The broad-band SED of the western hotspot is explained by a multi-zone emission scenario, where X-ray emission is caused by synchrotron emission process in the substructures embedded in the diffuse region, while the emission in radio to optical is caused by synchrotron emission process in the diffuse region.

Our broad-band spectro-temporal study and associated modelling of the core and hotspot of Pictor A (Fig. 1 and Fig. 2) suggests that (a) gamma-rays originate in the nuclear jet and not from the hotspot, (b) X-ray emission from the core of Pictor A has a nuclear jet-origin instead of previously reported disc-origin. (S. Gulati, Debbijoy Bhattacharya, M. C. Ramadevi, C. S. Stalin and P. Sreekumar, 2023, Monthly Notices of Royal Astronomical Society, 521, 2704; Link: <https://doi.org/10.1093/mnras/stad716>)

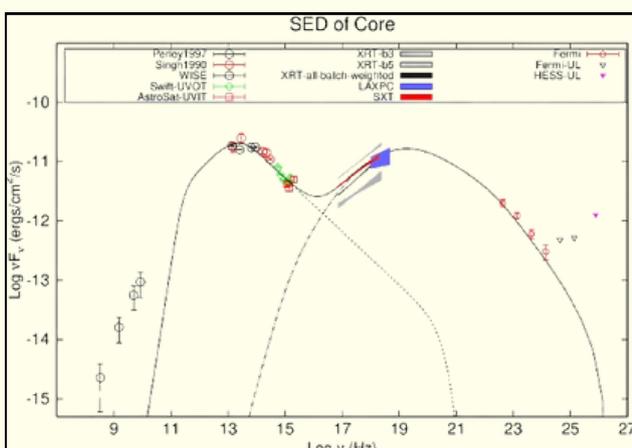


Figure 1: Broadband SED of the core

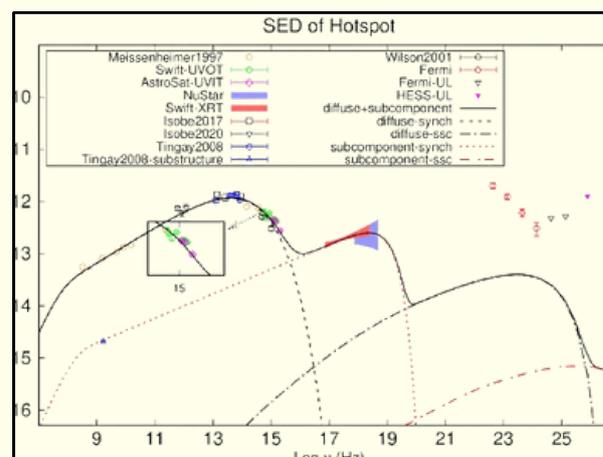


Figure 2: Broadband SED of hotspot

SUMMER RESEARCH INTERNSHIP (SRI) - 2023

SRI is an annual event at MCNS organized for about six weeks during June-July. It is intended to introduce young participants to the nuances of fundamental research from conceiving a fundamental problem to its solution and formal publication. Each intern works with his/her mentor on a specific research project, mainly on a contemporary topic. It includes seminar presentations and report writing. Participants receive certificates of internship.

The 2023 Summer Research Internship (SRI) program commenced on June 5th, 2023. From a large pool of applicants (204), five candidates who demonstrated exceptional research aptitude were selected. Dr. Narayana Sabhahit, the Pro Vice-Chancellor (Technology & Science) at MAHE, Manipal, graced the event's inauguration as the Chief Guest. Spanning over six weeks, this internship program provided the participants with exposure to research in fundamental Sciences, as well as a platform to interact with some of the world's most distinguished scientists hailing from India and abroad. The interns underwent a soft skill training session at the Centre, in addition to attending MAHE SRF courses given by Prof. P. Sreekumar and Dr. Debbijoy Bhattacharya.



At the end of the program (18 July 2023), the interns presented their research findings on their chosen topics. In recognition of their work, the students were awarded certificates of internship. The programme was coordinated by **Dr. Shalima P & Dr. Suranjan Shil**, Assistant Professors at MCNS.

SCIENCE OUTREACH ACTIVITIES

A brief account of the programmes under the MCNS outreach activities in 2023 are given below:

1. **Dr. T.M.A. Pai Planetarium:** MCNS is in charge of this planetarium, which helps taking science to general public and more specifically to school students. There are regular shows in English and Kannada. A total of 776 shows were screened during 2023 for 21138 viewers.

2. **National Science Day:** This is an annual program conducted in memory of Indian Nobel Laureate Sir C.V. Raman. This time MCNS organized a one-day workshop for school children on the theme "Frontiers in Science". **Dr. Rupak Roy** and **Dr. Chaitra U,** MCNS, coordinated this event.



Dr. Subir Bhattacharya from Bhabha Atomic Research Centre, Mumbai, delivered a lecture during the science day workshop organized for school/college teachers.



Students of MCNS demonstrating science experiments for school teachers



Dr. Sib Sankar Mal from NITK, Surathkal, delivered a lecture on "Applications of metals in biochemistry" during the science day workshop

STUDENTS' CLUBS ACTIVITIES

MCNS Students' Clubs given below, managed by the research students of MCNS, organized the following activities:

Reading Club: Reading club meetings were held wherein themes from the following documents were discussed:

- Detection of aromatic molecule Benzonitrile in the interstellar medium". Published in Science AAAS, 359 (6372) 2018. (04 Mar 2023).
- Did the Southern Western Ghats of peninsular India serve as refugia for its endemic biota during the Cretaceous volcanism? (01 Apr 2023)
- Charge radii of exotic potassium isotopes challenge nuclear theory and the magic character of $N = 32$ ". Published in Nature Physics, 17, Apr 2021. (06 May 2023).
- An infrared transient from a star engulfing a planet". Published in Nature. 617, May 2023. (01 Jul 2023).
- Stereoselective amino acid synthesis by synergistic photoredox-pyridoxal radical biocatalysis". Published in Science AAAS, 381 (6656) 2023. (05 Aug 2023).
- Free-diving sharks- Hammerhead sharks hold their breath when diving to regulate body temperature". Published in Science AAAS, 380 (6645) 2023. (01 Sep 2023).

Nature Club: The following were the nature club activities:

- Discussion on Common Medicinal Plants. (14 Jan 2023).
- Water and Complex Organic Molecules in the Solar System. (11 Feb 2023).
- Panel discussion on 'Imagining the Universe: How did it begin? Where will it go? (11 Mar 2023)
- Discussion session on birds with an expert (Ref. book, 'A Birder's handbook to Manipal' by Ramit Singal). (13 May 2023).
- Nature in Worship Traditions of Tulunadu" by Dr. Praveen Shetty. (08 Jul 2023).
- Discussion on water scarcity in the Udupi district. (12 Aug 2023).

Movie Club: The following were the movies recently screened:

- "The Quantum Indians"- Documentary (28 Jan 2023).
- "Earthquakes", episode 2 of the doc. series "Countdown to a Catastrophe" (25 Mar 2023).
- Night on Earth: Dark Seas [Episode 4] (27 May 2023).
- The Life and Work of Renowned Indian Astrophysicists [produced by Vigyan Prasar and IUCAA Pune] (24 Jun 2023).
- "Inside Einstein's Mind"- Documentary (22 Sep 2023).

EXPERT TALKS



Mr. Gautham Sabhahit



Dr. V. Girish



Dr. P.S. Athiray



Dr. Aravind Madhyastha

1. Invited talks at MCNS:

- **Mr. Gautham Sabhahit**, Armagh Observatory and Planetarium, UK, "Cosmic Challenges in Nuclear Astrophysics: The Indirect Approach", 04 Jan 2023.
- **Prof. Ranjeev Misra**, Senior Professor, IUCAA, Pune, "The Nobel road to observing black hole systems", 04 Feb 2023.
- **Prof. Dr. Banibrata Mukhopadhyay**, Senior Professor, Dept. Physics, Indian Institute of Science, Bengaluru, "X-ray imaging spectroscopy to study solar active region heating", 10 Feb 2023.
- **Dr. P. S. Athiray** from the University of Alabama, Huntsville, Center for Space Plasma and Aeronomic Research, NASA Marshall Space Flight Center, USA, delivered a seminar presentation titled "X-ray imaging spectroscopy for investigating solar active region heating" on June 1, 2023. Additionally, on June 2, 2023, he gave a public lecture on "My Experiences with Sounding Rockets: X-ray Study of the Sun".
- **Dr. V. Girish**, Deputy Director, Science Program Office, ISRO, Bangalore, "Space Science Programs of ISRO", 09 Jun 2023.
- **Dr. Abhiram Soori**, Asst. Prof., Dept. Of Physics, University of Hyderabad, "Scattering of Quantum particles in one dimension", 15 Jun 2023
- **Prof. Ishwara Chandra C. H.**, Professor & Dean, GMRT Observatory, NCRA-TIFR, Pune, "The Giant Metrewave Radio Telescope: A Technological and Scientific Milestone in Indian Science", 29 Jun 2023.
- **Dr. Aravind Madhyastha**, Convenor & Senior Fellow, SM Sehgal Foundation Center for Biodiversity and Conservation, ATREE, Royal Enclave, Srirampura, Bangalore. "Benson, Godwin-Austen and the current status of studies on non-marine molluscs of India" 16 Aug 2023.

2. Talks given at other institutions by MCNS faculty on invitation

- **Prof. P. Sreekumar**, Director, MCNS, presented invited talks at numerous institutions and events:
 - Spoke at the 'Student-Scientist Interaction Meet' held at Poornaprajna College, Udupi (15 Jun 2023).
 - Addressed the topic of "Space Exploration" during the ISRO Senior Management Training Meet in Bangalore (20 Jun 2023).
 - Delivered a talk titled "Exploring our solar neighborhood and beyond: Technology-critical science" at National Institute of Science Education and Research (NISER), Bhubaneswar (06 Sep 2023).
 - Delivered a talk titled "CHANDRAYAAN-3: Exploring the Untold Stories and Triumphs Behind Chandrayan's Success" at MIT, MAHE, Manipal (08 Sep 2023).
 - Delivered a lecture titled "India's Lunar Exploration Program" to the Astro Club & Project Kalpana at MIT (08 Sep 2023).
 - Engaged in 'Science Popularizing Programmes' for Pre-University level students at St Aloysius College, Mangalore (11 Sep 2023).
 - Spoke at the 'Engineers Day Celebration' held at the National Centre for Radio Astrophysics, Tata Institute of Fundamental Research, Pune (15 Sep 2023).
 - Delivered a talk titled "Development of X-ray Optics: Beyond AstroSat" at Giant Metrewave Radio Telescope (GMRT), Pune (15 Sep 2023).
 - Addressed the topic of "Lunar Exploration" at MGM College, Udupi (19 Oct 2023).
- **Dr. Sreejith Padinhatteeri**, Assistant Professor at MCNS, was honored as the chief guest and gave a presentation titled "Aditya - L1" during the Engineers Day celebration at Shri Madhwa Vadiraja Institute of Technology & Management (MVITM) in Udupi, Karnataka (15 Sep 2023).
- **Dr. Vivek Pandi**, Assistant Professor, participated as a guest speaker at a regional workshop organized by Stella Maris College, Chennai, emphasizing Plant Functional Traits and gave a lecture titled "Plant Functional Traits Analysis: Leaf Economic Spectrum" on 28 September 2023. Additionally, he delivered talks on the following topics:
 - "The Mangrove Ecosystems" at Centre for Outdoor Studies, MIT, MAHE, Manipal (11 Oct 2023).
 - "Biogeography and Paleobotany" during the RHATC Training Program at Zoo Outreach Organization, Coimbatore (17 Oct 2023).
- **Dr. Surajit Paul**, Associate Professor, MCNS delivered an invited lecture titled "Examining the Myths and Realities Surrounding Thermal and Non-Thermal Characteristics of Low-Mass Galaxy Clusters" at the ORIGINS Excellence Cluster in Germany on 18 October 2023.
- **Dr. Rupak Roy** and **Dr. Shalima P.**, Assistant Professors from MCNS, were specially invited as guests to engage with college students during a 'Mini-Physics Training & Talent Search Program' at PoornaPrajna College, Udupi held on 25 August 2023.

- **Dr. Debbijoy Bhattacharya**, Associate Professor, MCNS, was invited as a resource person for "Research in Astronomy: Opportunities and Challenges" in IUCAA-sponsored Southern Regional Astronomy Meeting and delivered a talk on "Study of Blazars in AstroSat era" (17 Feb 2023).
 - Invited review-talk on "Study of blazars in the AstroSat era" at the Eighth Regional Astronomy Meeting held at Rajagiri School of Engineering and Technology, Kakkanad, Kerala, February 18, 2023
 - Invited talk on "Gamma ray bright misaligned AGN and their possible connection with blazars" at the International Symposium on Recent Developments in Relativistic Astrophysics (ISRA) held at Shri Ramasamy Memorial (SRM) University Sikkim, Gangtok, 12 December 2023.
 - Invited talk on "Expected impact of XPoSat on Active Galactic Nuclei" at ISRO HQ, 25 May 2023
 - Talk on "Study of active galaxies in the Fermi and AstroSat era" at North Bengal University, 14 December 2023

WORKSHOP AND TRAINING

• Training program on ground-water exploration using Electrical Resistivity Methods

A 15-day intensive training course on Groundwater Exploration Using Electrical Resistivity Methods was organized by the Geohydrology Consultancy and Skill Development Cell, MCNS, Manipal, from June 12-28, 2023. The primary goal of the training programme was to supply the region with expert geologists with hydro-geophysical knowledge in groundwater exploration. The training program aimed to impart wisdom and skills to solve certain genuine difficulties the industries are experiencing. This initiative was to provide opportunities for geology academics, postgraduate students, and professionals and strengthen the industry-academia collaboration. The training program included the following topics:



Participants involved in field training

- Introduction to Geophysical Methods
- Hands-on demonstration of various instruments and procedures.

The training was organized by **Prof. Narayana Shenoy K**, MCNS

• Beginning Astronomy: Start a data-driven journey

A 3-day workshop, "Beginning Astronomy: Start a data-driven journey", jointly organised and funded by IUCAA and MAHE, was conducted at MCNS, MAHE, on February 02-04, 2023. Around fifty students from various institutes and universities attended this workshop. In this 3-day workshop, the students were introduced to some core concepts in stellar and galaxy astrophysics through a mix of short lectures and hands-on computational sessions with publicly available astronomical databases. Dr Debbijoy Bhattacharya was the coordinator from MCNS. Dr Souradeep Bhattacharya, Dr Preetish Mishra, and Dr Chayan Mondal were the coordinators from IUCAA.

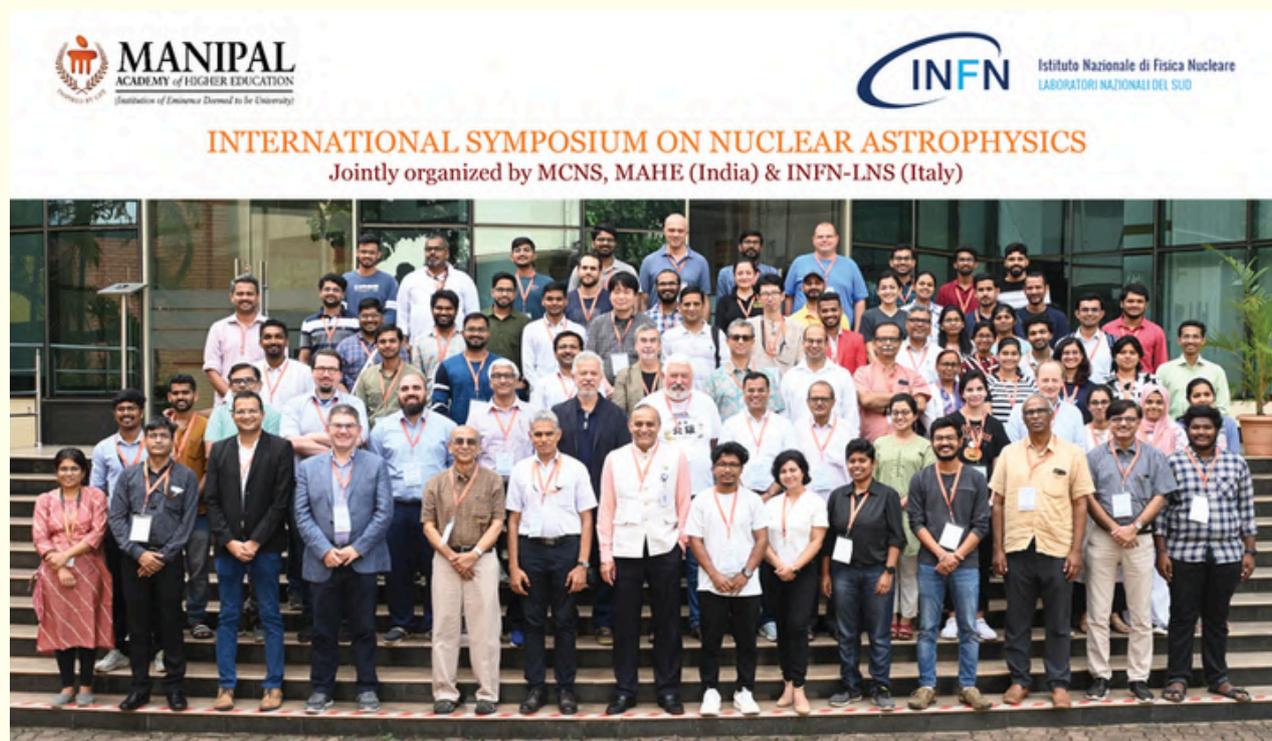


Participants from different colleges attending the workshop

- **International Symposium on Nuclear Astrophysics (ISNA-2023, October 30 to Nov 02)**

ISNA - 2023 was jointly organized by MCNS & INFN- LNS (Italy) from October 30 - November 3, 2023. It was a first-of-its-kind event in India. The objective of the ISNA - 2023 was to bring together a diverse group of researchers across the globe who work on nuclear physics (experiments and theory), astrophysics & astronomy (observational and experimental) to serve the needs of the growing interdisciplinary branch of Nuclear Astrophysics. It was attended by 70 outstation participants from India & abroad and 20 from MCNS. ISNA - 2023 witnessed active participation from various national institutes.

The foreign participants were mainly from INFN-LNS (Italy), Uppsala University (Sweden), GANIL & IJCLab-Orsay (France), MSU (USA), Texas A & M (USA), Notre Dame Uni (USA), Ohio University (USA), ELI-NP (Romania), University of Tokyo (Japan), Univ. of Wroclaw (Poland) and JINR (Russia). There was a total of 32 invited talks and 30 young researchers' presentations (Oral & Posters). In addition, two public talks were delivered by Dr. Amit Roy (former Director, IUAC, New Delhi) and Dr. Vinod Kumar (ISRO). All the invited talks and contributed oral presentations will be published in EPJ Web of Conference Proceedings. ISNA - 2023 was supported by various national funding agencies such as SERB (New Delhi), DAE-BRNS (Mumbai), and INSA (New Delhi) etc. In addition, ISNA- 2023 enjoyed sponsorship from SBI, CAEN-INDIA & EPJ Young Researcher Attendance Grant as well.



Participants at the symposium

- **A Mini - symposium on 50 Years of Nuclear Physics Research in India (December 05, 2023)**

A mini - symposium was held to bring together a few expert nuclear physicists in the country to discuss the early beginnings and progress in the last 50 years of nuclear physics research in India. It was the vision and leadership of Dr. Homi Jehangir Bhabha that triggered the early establishment of nuclear power research in India - for both civilian applications and as a military deterrent. India has made great strides in nuclear research in the years since then, and the symposium was to trigger a relook at the progress made.



Open panel discussion during the symposium

The program included the following:

- Screening of the seminar: "Dr. Homi J Bhabha: A Legend lives on", by Dr. P.R. Vasudeva Rao.
- A seminar on "Neutron interactions and fission reactor concepts", by Dr. V. Gopalakrishnan.
- Open panel discussion on the theme: "Historical connections : nuclear particle physics, cosmic ray studies and gamma-ray astronomy". Panelists: Dr. P. Sreekumar, Prof. B. S. Acharya, and Dr. B. Satyanarayana.

- **Book Review and exhibition at MCNS**



Students and faculty during the book exhibition at MCNS

The MCNS library organized a Book Review Event for 7 days, from August 29 to September 4, 2023. This event offered students an opportunity to explore into books by various authors and publishers in the domain of physical sciences. Additionally, the library arranged a one-day book exhibition on September 9, 2023, featuring subject areas such as physical sciences, evolutionary biology, programming, and general reading.

This events were coordinated by **Dr. Jessy Saadi**, Librarian, MCNS.

NEW JOINEES



Dr. Surajit Paul, Associate Professor, joined the Centre in June 2023. His research interests are in Astronomy and Astrophysics and Cosmology.



Dr. Ashwini U, Senior Staff Scientist, joined the Centre in November 2023. Her research interests are Neutron Dosimetry, Radiation Dosimetry, Monte Carlo simulations and Space radiation.



Dr. Joby Panakkal Kochappan, Post-doctoral Fellow, joined the Centre in November 2023. His area of research is in Cosmology.



Mr. Abhishek Jhala, Junior Research Fellow under ISRO funded project, joined the Centre in April 2023



Ms. Muskan, Project Associate-1 under SERB funded project, joined the Centre in December 2023.

AWARDS AND RECOGNITIONS

• Faculty of MCNS

- **Professor P. Sreekumar**, Director of MCNS, has been recognized as a member of the Global Expert Group for Sustainable Lunar Initiatives (GEGSLA) Austria since August 2023.
- **Dr. Vivek Pandi**, Assistant Professor, MCNS has become a member of Editorial Board of npj Biodiversity, an online OA journal publishing, London.
- **Dr. Chandrachur Chakraborty**, Assistant Professor, MCNS has become a member of International Astronomical Union (IAU) from May 2023.
- **Dr. Rupak Roy**, Assistant Professor, MCNS has been awarded a 'Visiting Associateship' at the Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune for a three-year term starting in August 2023.
- **Dr. Sreejith Padinhatteeri**, Assistant Professor, MCNS received an invitation to witness the commencement of the PSLV-C57/Aditya L1 mission launch on September 2, 2023.

- **Dr. Surajit Paul**, Associate Professor at MCNS, has received a research funding to visit the Chair of Astronomy at Julius-Maxilians Universität Würzburg in Germany. He has been recognized with the following honors:
 - Designation as a 'Visiting Scientist' at the Excellence Cluster ORIGINS, Germany, from October 15 to November 14, 2023.
 - Awarded a 'Visiting Associateship' at the Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune, for a three-year term starting in August 2023.
- **Student of MCNS**
 - **Adithya HN**, Ph.D. scholar of MCNS had the privilege of visiting the Institute for Space Earth Environment (ISEE) at Nagoya University in Japan to work on the development of the 'Database for Solar Soft X-ray (Hinode/XRT) and (E)UV (SDO/AIA & PROBA2/SWAP) Irradiance Variability from 01-10-2023 to 14-10-2023. Received financial support from the Scientific Committee on Solar-Terrestrial Physics and ISEE, Nagoya University.

ACHEIVEMENTS

- **Faculty of MCNS:**

- **Dr. Sumana Nandi**, Assistant Professor, MCNS received a research grant from Science and Engineering Research Board (SERB), Govt. of India for her project entitled "Radio loud AGN jets: their evolution, intermittency & precession".

- **Students of MCNS:**

- **Ms. Sanna Gulati**, Ph.D. scholar of MCNS was awarded a doctoral degree for her thesis titled "Studies on High Energy Emission Process in Misaligned Active Galaxies" under the guidance of Dr. Debbijoy Bhattacharya, Associate Professor, MCNS.
- **Ms. Suvedha Suresh Naik**, Ph.D. scholar of MCNS was awarded a doctoral degree for her thesis titled "Cosmic Inflation: Theoretical Exploration and Observational Constraints" under the guidance of Dr. Kazuyuki Furuuchi, Associate Professor, MCNS.
- **Ms. Gayathri Rajendiran**, Ph.D. scholar of MCNS received a Seed Research Grant from the Association for Tropical Biology and Conservation (ATBC), a prestigious recognition designed to support research initiatives centred around tropical biology and conservation (01 June 2023).

OBSERVANCE OF IMPORTANT DAYS



Dr. Sreejith, Assistant Professor, MCNS, delivered a talk during world space week celebration at MCNS



Quiz program held at MCNS during Swatchatha Pakhwada-2024 celebrations at MCNS



Teachers' day celebrations at MCNS organized by the students



Celebrating "Vanamahotsava", a tree-planting drive at MCNS



World water day - 2023 celebrations at MCNS



Celebration of launch of India's 1st dedicated space mission to study the Sun

PUBLICATIONS

Journal Articles

- Lalitha Devi, **U. Chaitra**, Shashikanth Hathwara and Akshayakumar Kompa. Influence of starch capping effect on optical absorption and photoluminescence behaviour of ZnS nanoparticles. *Inorganic Chemistry Communications*, 2023, 149 (110374).
- Ailawadhi, R Dastidar, K Misra, **Rupak Roy** et al. Photometric and spectroscopic analysis of the Type II SN 2020jfo with a short plateau. *Monthly Notices of the Royal Astronomical Society*, 2023, 519 (1): 248-270.
- Sushobhan Ghosh, Sudip Sarkar, Satadal Paul, **Suranjan Shil** et al. Highly luminescent and semiconducting supramolecular organic charge transfer complex generated via h-bonding interaction pathway. *Crystal Research and Technology*, 2023, 58 (2200228).
- Manoj Varma, **Sreejith Padinhatter**, Sakya Sinha, Anurag Tyagi et al. The solar ultra-violet imaging telescope (SUIT) onboard intelligence for flare observations. *Solar Physics*, 2023, 298 (2).
- Subhashree Swain, Gulab Chand Dewangan, **P Shalima**, Prakash Tripathi and K V P Latha. Multiwavelength study of NGC 1365: The obscured active nucleus and off-nuclear compact X-ray sources. *Monthly Notices of the Royal Astronomical Society*, 2023, 520 (3): 3712-3724.
- Akshayakumar Kompa, B. Lalitha Devi and **Chaitra U.** Determination of optical constants of vacuum annealed ZnO thin films using Wemple Di Domenico model, Sellmier's model and Miller's generalized rules. *Materials Chemistry and Physics*, 2023, 299 (127507).
- **Sanna Gulati**, **Debbijoy Bhattacharya**, M. C. Ramadevi, C. S. Stalin and **P. Sreekumar**. Multiwavelength study of radio galaxy Pictor A: detection of western hotspot in far-UV and possible origin of high energy emissions. *Monthly Notices of the Royal Astronomical Society*, 2023, 521 (2): 2704-2715.
- Vibhuti Vashi, Rajnikant Makwana, B. Quintana, M.H. Mehta, R.K. Singh, B.K. Soni, R. Chauhan, S. Mukherjee, M. Abhangi, S. Vala, N.L. Singh, G.B. Patel and **S.V. Suryanarayana**. Systematic study of (p, n) and (p, 2n) reactions on ¹¹⁰Cd. *Radiation Physics and Chemistry*, 2023, 208 (110933).
- Soumik Das, Anirban Misra and **Suranjan Shil**. Metallocene-coupled cumulenes: a quest for chiral single-molecule magnets. *Physical Chemistry Chemical Physics*, 2023, 25 (11816).

- **Suvedha Suresh Naik**, Pravabati Chingangbam, and **Kazuyuki Furuuchi**. Particle production during inflation: constraints expected from redshifted 21 cm observations from the epoch of reionization. *Journal of Cosmology and Astroparticle Physics (JCAP04)*, 2023, 058.
- **Suranjan Shil**, Debojit Bhattacharya, Anirban Misra, Yenni P. Ortizd and Douglas J. Klein. The effect of hetero atoms on spin exchange coupling pathways (ECPs): a computational investigation. *Physical Chemistry Chemical Physics*, 2023 (21).
- **Vivek Pandi**, Kanda Naveen Babu, and Ashaq Ahmad Dar. Differential impact of liana colonization on the leaf functional traits of co-occurring deciduous and evergreen trees in a tropical dry scrub forest. *Journal of Plant Research*, 2023.
- Sudip Sarkar, **Suranjan Shil**, Sudip Mohapatra, Gobinda Chandra De and Sushobhan Ghosh. Temperature-Dependent Semiconducting Behavior of an Organic Cocrystal Driven by the Stacking Mode of Interaction of a 4,4'-Bipyridine Molecule. *Crystal Growth and Design*, Jul 2023.
- **Chandrachur Chakraborty** and Parthasarathi Majumdar. Gravitational Larmor precession. *European Physical Journal C*, 2023.
- Swagato Dasgupta, Soumyajit Mukherjee, **Naimisha Vanik**, Rima Chatterjee and Sanjit Kumar Pal. Paleostress analysis and rift kinematics of the petroliferous Barmer rift basin, western Rajasthan, India. *Marine and Petroleum Geology*, 156 (2023).
- **Naimisha Vanik**, Atul Kumar Patidar, Abhishek Kumar, Alin A L and Vidushi Mishra. Terrain analysis and hydrogeomorphic investigation of the Sita-Swarna River basin, Udupi, SW India: Insights from remote sensing methods. *Quaternary Science Advances*, 12 (2023).
- Suman Das and **Sumit K. Garg**, Chethan Krishnan & Arnab Kundu. Fuzzballs and random matrices. *Journal of High Energy Physics (JHEP)*, 31 (2023).
- **Chandrachur Chakraborty** and Banibrata Mukhopadhyay. Geometric phase in Taub-NUT spacetime. *European Physical Journal C*, 2023.
- **Paresh Prajapati** et.al.; Nuclear physics midterm plan at LNS. *European Physical Journal Plus*, 2023.
- Prateek Gupta and **Surajit Paul**. Adaptive friend-of-friends algorithm for identifying gravitationally bound cosmological structures. *Physical Review D*, 108 (2023).
- **Sreejith Padinhattheri** et.al.; The Solar Ultraviolet Imaging Telescope: detector characterization and read out electronics testing. *RAS Techniques and Instruments*, 2 (1) 2023.

- **Books/Chapters**

- **Vivek Pandi.** Taxonomy and Ecology of Climbers: Climbing Plants of India (Ed.1). Springer Nature (Singapore) 2023, ISBN: 978-981-19-8645-1& 978-981-19-8644-4.
- **Sreekumar P.** Antharikshakke Hosa Chakshu (book: Khagola Darshana: Antharishakke Hanta Hantada Mettilu). Navakarnataka publications Pvt. Ltd. 2023, ISBN: 8196401752.

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ABOUT MCNS

The Manipal Centre for Natural Sciences (MCNS) was started in 2011 under the Manipal Advanced Research Group (MARG). The primary aim of MCNS is to nurture fundamental research in the Natural Sciences and grow into a hub of excellence within Manipal Academy of Higher Education. In 2012, MCNS came to be recognized as a Centre of Excellence under Manipal Academy of Higher Education. It is one of the first dedicated "all-research" Centers to be started within a university.

From its inception, a unique and vibrant academic program has been initiated and integrated with existing research at partner institutions in India and abroad. The Centre has been striving to promote fundamental research in the forefront areas of natural sciences. The Centre presently has both academic and research programs

ACADEMIC PROGRAMS AT MCNS

- Ph.D. in Physics, Biological Sciences, and Chemistry
- Integrated M.Sc.-Ph.D. in Physics

ADVANTAGE

Research at MCNS is in niche, emerging and inter-disciplinary areas of science, which makes the Centre a unique research destination. The Post-Doctoral program, is specially structured to nurture independence and creativity in research, and collaborates with similar programs abroad, to encourage exchange and mobility. MCNS provides a stimulating environment towards a future scientific leadership in the emerging fields, by encouraging blue sky research in all the branches of Natural Sciences. MCNS is also recognised as one of the Inter- University Centre for Astronomy and Astrophysics (IUCAA) for Astronomy Research and Development.

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