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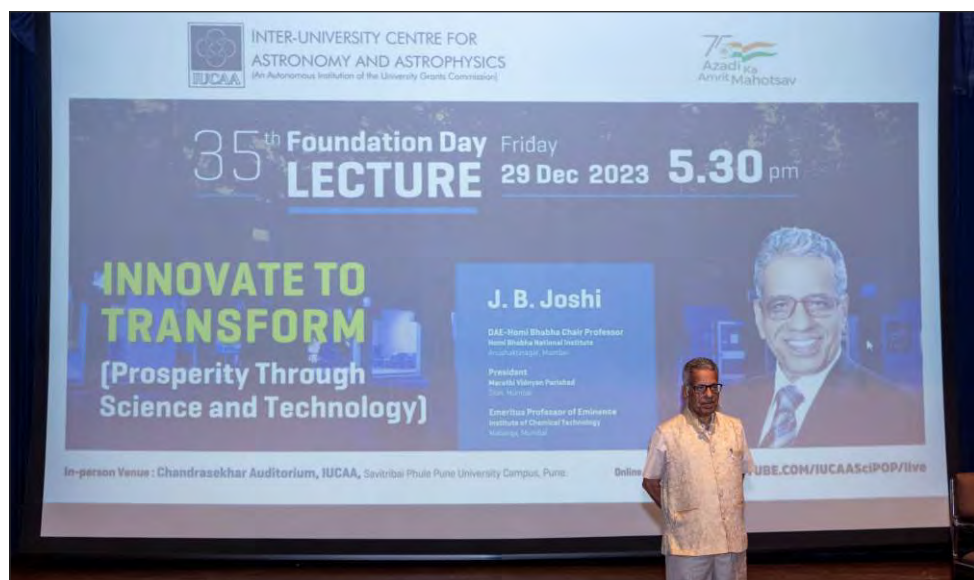
At the helm

IUCAA is happy to announce the appointment of Professor R. Srianand as the new Director, effective 01 December 2023



The Thirty-Fifth Foundation Day Lecture

Innovate to Transform: Prosperity through Science and Technology



The 35th Foundation Day lecture was delivered on Friday, December 29, 2023, by Padma Bhushan Dr. Jyeshtharaj B. Joshi, DAE-Homi Bhabha Chair Professor, Homi Bhabha National Institute, Anushaktinagar Mumbai, President, Marathi Vidnyan Parishad, Mumbai and Emeritus Professor of Eminence, Institute of Chemical Technology, Mumbai.

Dr Joshi, a renowned chemical engineer, is well known for developing novel processes, designs, and products implemented in large, medium and small-scale industries, including designing more than 1000 reactors for commercial operations. He received accolades for his outstanding contribution to multiphase reactors. Dr. Joshi has developed efficient designs of cookers and stoves and has conducted more than 300 workshops to promote science awareness among school children. As the President of the Marathi Vidnyan Parishad, Dr Joshi has actively driven the task of improving the scientific temper of the society through different activities. Dr. Joshi's achievements have been recognised both nationally and internationally, and, amongst other accolades, he is the recipient of the Shanti Swarup Bhatnagar Award in Engineering Sciences (1991) and the Eminent Engineer Award by the Engineering Council of India (2018). An eminent academician, Dr Joshi

has supervised 91 PhD and 60 master's students, published 600 papers in international journals and has more than 17000 citations with an h-index of 64.

Dr Joshi's lecture was titled, 'Innovate to Transform (Prosperity Through Science and Technology)'. Dr Joshi expressed his happiness at the outset and said he was honoured and privileged to deliver the prestigious Foundation Day lecture at IUCAA. Dr Joshi informed the audience that the principal subject of this talk would focus on one of the objectives of the Marathi Vidnyan Parishad, which he headed to promote science and technology for societal improvement. He lauded the founders' efforts, including Professor Udgaonkar and Professor Narlikar, towards popularising, strengthening, and activating the organisation.

Dr Joshi explained that the Marathi Vidnyan Parishad aimed to explore how science and technology could be used to solve societal problems and enhance the nation's wealth. The methodology involved collaboration with the Institute of Chemical Technology, Bhabha Atomic Research Centre, JB Joshi Foundation, Vidyan Ashram, Pabal, Dist. Pune, and various industries. Prof. Joshi presented data on India's GDP ranking, innovation ranking, and per capita income, highlighting the country's low position in

GDP and innovation. He discussed the potential of technology in increasing agricultural productivity and generating income, using the example of biomass pyrolysis. The findings demonstrated that implementing biomass pyrolysis technology in a cluster of five villages could significantly increase income, potentially generating 161 crores—the importance of leveraging science and technology for societal and economic development.

The second example was to develop and implement efficient cookstove technology in India to address the inefficiencies and health hazards associated with traditional cookstoves. The research problem focused on the low efficiency [12%] and high pollution levels of conventional cookstoves, which led to health issues and economic burdens. The aim was to improve the efficiency to 42%, develop affordable hardware, and address the practical challenges women faced in using improved cook stoves. The research design involved computational fluid dynamics to analyse the cook stoves' oxygen distribution and volatile release. Hardware was developed based on the findings, and workshops were conducted with women to understand their needs and challenges. The context of the study included rural areas in India, with a focus on Maharashtra and Gujarat. The efficiency of the cook stoves was successfully improved to 52%, leading to reduced pollution levels. Women were willing to pay between 700 and 1000 rupees for the improved cookstoves, indicating the potential for acceptance and adoption. The implementation of efficient cookstove technology has the potential to significantly reduce indoor pollution, improve health outcomes, and create economic opportunities. The study attracted international attention, with researchers from MIT expressing interest in similar work.

In the third example, Dr. Joshi discussed the development and implementation of technology to recover titanium and produce carbon nanotubes. The background of the research was the high

cost of importing titanium and carbon nanotubes, prompting the need for domestic production. The aim was to develop domestic technology for economic and national benefit. The methodology involved a pilot plant for titanium recovery, developing carbon nanotubes, and implementing applications such as bulletproof jackets, hydrogen storage, and composite materials.

The results include

- Successful production of titanium at a lower cost.
- Development of carbon nanotubes for various applications.
- The commercialisation of bulletproof jackets.

The research implications include reduced dependency on imported technology, economic benefits, and the nation's empowerment with domestic technology.

In conclusion, Dr Joshi emphasised the need for an enlightened society to ensure enlightened innovators and generate wealth for the nation. He also highlighted

the importance of implementing technology for societal benefit and announced the upcoming launch of an MBA program in social entrepreneurship. He further emphasised on the potential for societal and economic impact through the implementation of technology and the cultivation of scientific temper. Dr Joshi

highlighted and appreciated IUCAA's role in promoting scientific temper and expressed interest in collaborating with IUCAA.

The lecture ended with a lively discussion with the audience and questions taken online over YouTube.

The recorded lecture is available at the YouTube link:

https://www.youtube.com/live/Fa_jcLmY3YA?si=af8sRQ-Hoplulfyg



Research Highlights

Cracking the Mystery of Compact Stars with Gravitational Waves



17 August 2017: A ground-breaking announcement by the LIGO Scientific Collaboration revolutionised the landscape of modern astronomy. A gravitational wave signal had been detected from a collision of two Neutron Stars, suggesting a novel technique to probe the interior of massive compact objects directly. This event, followed by detections of electromagnetic signals at multiple wavelengths by telescopes observing the same source, confirmed several hypotheses associated with such merger events and thus ushered in a new era of Multi-messenger astronomy.

Neutron stars [NS] are compact objects formed when massive stars end their lives in cataclysmic supernova explosions. Discovered serendipitously at radio frequencies by Jocelyn Bell, a graduate student at Cambridge University, in 1967, these compact stars have been observed throughout the electromagnetic spectrum. But there has been no

possibility to probe directly into the mysterious interior of such objects until recently.

The enigmatic interior of neutron stars provides clues about the properties of matter far beyond our current understanding. Being the densest possible object in the Universe, neutron stars allow us to see nature at its most extreme. Their dense interior may harbour a zoo of strange particles such as hyperons [strange baryons] or quark matter [fundamental constituents of particles]. Our knowledge of the fundamental constitution of matter is limited to terrestrial experiments, such as those performed in nuclear laboratories or heavy-ion experiments at particle accelerators. But neutron stars surpass our current understanding of dense matter by several orders, so one resorts to theoretical models to explain their behaviour and compare the theoretical predictions with astrophysical data. However, the uncertainties in observational data analysis and extrapolation of our current theoretical understanding to unknown

regimes do not allow us to constrain the models precisely.

The breakthrough in this field came with the discovery of gravitational waves (GW) - ripples in space-time produced when massive cosmic objects collide or are perturbed. Although predicted by Einstein back in 1915, these elusive waves could not be detected given their extremely weak nature: their amplitude is one part in a septillion! Catching a gravitational wave required a century of technological advancement to build one of the most precise instruments in the world, a gravitational wave detector. Huge "L" shaped detectors with several kilometre arm lengths were suspended in ultra-high vacuum to isolate them from surrounding vibrations. At the same time, powerful lasers were made to reflect in the arms multiple times and then interfere so that any passing wave would change its pattern. These detectors, such as the LIGO detector in the US and Virgo detector in Europe, were then successively upgraded over a decade to reach their design sensitivity when they ultimately discovered the first GW signal from a pair of binary black holes in 2015 and soon after, from a pair of neutron stars in 2017.

Research

The NSGW group at IUCAA, led by Debarati Chatterjee, studies fundamental physics using gravitational waves. Over the past few years, the group made several remarkable contributions to research, with implications for multidisciplinary domains such as Nuclear Physics, Particle Physics and GW astronomy.

In particular, several studies led by PhD student Bikram Keshari Pradhan (published in Nuclear Physics A, Physical Review C, Physical Review D and the Astrophysical Journal in 2022-2023) searched for signatures of the neutron star's internal composition in unstable oscillation modes that lead to continuous GW emission. The results showed that dense matter theories in nuclear physics could be better constrained using signals from such oscillations, in both isolated NSs or binary, by planned future-generation GW detectors. They also investigated how such detections may allow us to distinguish between neutron stars and other stable families of compact stars, such as strange stars, or probe the nature of a possible phase transition in their interior. In a series of works led by PhD student Suprovo Ghosh, constraints were imposed on dense matter theories using multidisciplinary Physics (nuclear theory, heavy-ion physics, Multi-messenger astrophysical data) at different densities. PhD student Swarnim Shirke extended this scheme to hybrid stars (with phase transition in the interior) by additionally imposing constraints from perturbative theories of QCD (Quantum Chromodynamics, the theory of strong interaction) at very high densities. These works were published in the European Physical Journal, Frontiers in Astronomy and Space Sciences and the Astrophysical Journal in 2022-2023.

Suprovo Ghosh also proposed tidal heating in the initial inspiral phase of NS mergers as a novel probe of strangeness. Further, Swarnim Shirke is investigating the possibility of detecting exotic matter in the interior of neutron stars. In his recent work

published in the Journal of Cosmology and Astroparticle Physics, NS oscillation modes were suggested as a new probe of the presence of dark matter in NSs. Post-doctoral student Dhruv Pathak collaborated in several of these efforts and led studies to improve limits for continuous GW searches by LIGO.

The best is yet to come in GW research.

As the current generation (LIGO-Virgo-KAGRA) of GW detectors near the end of their fourth observation run, many more are on the horizon. In May 2023, the Indian government gave the final nod to constructing a GW detector on Indian soil. Joining the global array of GW detectors, the LIGO-India project will revolutionise the landscape of GW research with its cutting-edge technology and global position, leading to a highly accurate localisation of GW sources. Future-generation detectors such as the Cosmic Explorer in the US, the Einstein Telescope in Europe, and the space-based Laser Interferometer Space Antenna (LISA) are planned over the next decade. A dedicated high-frequency GW interferometer called NEMO (Neutron Star Extreme Matter Observatory), designed to measure the fundamental properties of nuclear matter at extreme densities with GWs, has also been proposed. Joining hands with space and ground-based telescopes, multi-messenger collaborative research on neutron stars is expected to crack the code in mysteries of fundamental physics, from the infinite to the infinitesimal.



Debarati Chatterjee is a Theoretical Astrophysics researcher specialising in Compact Stars and Gravitational Waves. She is an Associate Professor at the Inter-University Centre for Astronomy and Astrophysics, Pune, India, and a member of several international collaborations, including LIGO Scientific Collaboration. She is the current Chair of Education and Public Outreach for the LIGO-India mega-science project.

Beyond academics, Debarati is passionate about creative writing, learning new languages, dancing, and sports like high-altitude trekking, rock climbing and mixed martial arts.



The Kerala Story

Over the past few decades, Astronomy and Astrophysics have taken a strong foothold in the southern reaches of India. An integral component of this has been the early interaction of IUCAA scientists with university researchers in Kerala, which further spread to other areas. In this article, I recount below this journey of A&A research and activities in Kerala: the Kerala story.

The Kerala story has multiple pathways, and the present narration is just one of them. The other two originated in Trivandrum and Cochin University [CUSAT]. It all started with Ajit Kembhavi's visit to Cochin University to promote astronomy research, where Moncy V John [standing with his wife and two kids on the right of Naresh Dadhich in the first figure] and I were doing our PhD. Ajit Kembhavi, as always, gave us a very enthusiastic narration of the opportunities in doing research with worldwide connectivity [at that time through the Education and Research Network of India ERNET] and the upcoming opportunities in astronomy. We, dependent on the university library internet connectivity for getting research abstracts of journals, were overwhelmed by the offer and asked Ajit Kembhavi whether he would be willing to extend these facilities to our college. As usual, his answer was Yes! More than that, he offered to drop in at our college on his way to Trivandrum. We returned to college and informed the manager, Mar Chrysostom [leftmost in the second figure with Jayant Narlikar [Director, IUCAA], Naresh Dadhich, Ajit Kembhavi [both later became directors of IUCAA] and K. Babu Joseph [later became vice-chancellor of CUSAT]], who immediately initiated the arrangements for the meeting. A computer was set up, and his personal phone connection was offered for a dial-up STD connection to IISc Bangalore. When Ajit Kembhavi arrived, he came with a domain name stthom.ernet.in and a dial-up connection to IISc Bangalore. St Thomas College turned out to be the first college in the country to have an ERNET domain name and full internet connectivity [well, ten kbps was the maximum speed in those days for dial-up connection!]. It was just the beginning of a new era.



Fig.1 This is a 1997 Charal Mount, Kerala workshop photograph. In the picture from left, T Georg Varghese [HoD of Physics, St Thomas College, Kozhencherry], Ajit Kembhavi, the author and his family and Naresh Dadhich, Moncy and his family.



Fig.2 This is a photograph taken during the public meeting held during the 1997 workshop. From left, Rt. Rev Mar Chisostom, Jayant Narlikar, Babu Joseph [CUSAT], Ajit Kembhavi and Prof. Naresh Dadhich.

In December 1997, the state had the first IUCAA workshop with the participation of faculty from several colleges in and around central Kerala [the second figure is a photograph from the public meeting held during that workshop]. Joe Jacob from Newman College, Thodupuzha, was one of the participants, and, in later years, he coordinated outreach activities of IUCAA all over Kerala with his inborn skill. The other person who is not with us anymore but has contributed a substantial role in the outreach activities of IUCAA in the state is V C Kuriakose from Cochin University.

In 1999, a mini-workshop on computer astronomy was held at Charal Mount, a hill campus near St Thomas College, where Yogesh Wadadekar and Sarah Ponarathnam came with three computers from IUCAA to give training to the

participants. They set up a computer network of half a dozen computers for hands-on training. To appreciate the efforts appropriately, one should look at the computing facility IUCAA had in those days [Fig 3]. Not surprisingly, the workshop was well accepted and resulted in great motivation for everyone involved.

The same year, the IUCAA Resource Center was set up at CUSAT under the eminent leadership of V C Kuriakose. Though V.C. Kuriakose himself was a theoretical physicist, his contribution to the popularisation of astronomy and the conduct of workshops, training programs, etc., in colleges and universities across the state is innumerable. Notably, he conducted dozens of telescope-building programs for school students. It is right to say that the Kerala astronomy activities are

satellites around him, and his absence is the most significant loss the Kerala astronomy community has ever had to undergo. During his tenure, Kerala astronomy flourished to a self-sustaining status, and over 300 workshops and training programs were organised at state, national, and international levels.

K Indulekha, Vinu Vikram, Minu Joy and several others from MG University, V.C. Kuriakose, Vivek M, Tharanath, Nijo, etc. from CUSAT, B.R.S. Babu, C D Ravikumar and many others from Calicut University have all contributed to the spread of astronomy research in the state.

Of the various programmes taken up during the International Astronomy Year 2009, a significant outreach activity to village schools in the Idukki district of Kerala under the label "Sasthagramam" was carried out by Joe Jacob and Ravi Pillai (Newman College, Thodupuzha) in collaboration with the social organisation for the upliftment of women, "Kudumbasree". They conducted a sequence of programs and competitions for the students. The final round of twenty students who topped in these programs were brought to IUCAA, where they interacted with faculty members and research students and visited various facilities like the IGO, GMRT, etc. This was an unforgettable experience for the leaders and the children.

Nijo Varghese (S H College, Chalakudy) and R Tharanath (Aquinas College, Kochi) and their group continue the legacy of telescope building, astrophotography, and astronomy outreach programs in memory of V.C. Kuriakose in and around central Kerala. They procured a telescope in 2020 that is used specifically for this purpose under the banner of the Astronomical Society of Kerala [ASK].

The Kerala story does not end by organising workshops and training programs to create human resources. It has also contributed to the national and international research in astronomy, cosmology and astrophysics. When this collaboration published the machine learning tool for star-galaxy classification in 2002, fewer than half a dozen use cases for AI were reported in astronomy and astrophysics. However, on average, more than a dozen papers using these techniques now appear

daily in archives.

Another outcome of this collaboration is that the Quasar catalogue published by Sheelu Abraham et al. could correctly predict more than 99% of the quasars detected in 2012 and is over 96% accurate even today. This is despite the ten-year development in technology and learning models.

During his PhD, Vinu Vikram (Central University, Kasaragode) developed a pipeline called Pymorph, which is widely used by the astronomy community nowadays to discover Galaxies' morphological and structural parameters. He used it to extract the parameters of the galaxies in the Hubble space telescope and Sloan Digital Sky Survey.

A notable contribution of the IUCAA collaboration was the discovery of the Galaxy Supercluster Saraswathi by Joe Jacob et al., under the leadership of Joydeep Bagchi, which received worldwide attention.

The collaboration has grown such that over the 28-plus years, several cutting-edge and advanced techniques for image and spectral classifications using ground telescopes, Transient classification in LIGO detectors, application of Natural Language Processing for observatory maintenance, etc, were developed and applied by the group to astronomy research and beyond. International collaborations and bilateral projects spawn as natural outcomes of these collaborations. Researchers were involved in the Virtual Observatory project, LIGO, CRTS, SALT, SKA and many other international programs. The founding membership in the SKA India Consortium is just one example of the active participation of astronomers from the state in such collaborative programs.

The models developed for astronomy research have also been extended to other fields. The Pune Knowledge Cluster, the IUCAA associateship, and the High-Performance Computing Facility at IUCAA deserve honourable mention in these aspects. Papers in reputed journals like Nature for Protein Particle Picking from CryoEM images, behavioural studies of insects, morphological alterations in macrophages, etc., in collaboration with

National Cell Sciences [NCCS], collaborative projects with the National Chemical Laboratory [NCL] for the use of Digital Twins for DME manufacturing plants, Solid Hydrogen Storage, etc., in which the author was also a participant would not have been possible without this collaboration.

In the first picture, the other young boy is Joe Philip Ninan, who became a full-time astronomer and faculty member at TIFR, Mumbai. A name that should be associated with Joe's journey to astrophysics is that of the late Paul Kodiyan Thomas, HOD, Department of Physics and Electronics, CHRIST (Deemed to be University). Like V.C. Kuriakose, Paul Kodiyan Thomas played a pivotal role in cementing the foundation for astronomy research at Christ University, Bangalore.

Kerala Astronomy gradually matured, and since 2014, with the first independent gathering of Kerala Astronomers at MACFAST, Thiruvalla, it has continued every year with growing enthusiasm. Known as the Regional Astronomers Meet now, it also has its presence outside the state. The 9th meeting was conducted at the Manipal Center for Natural Science [MNCS] this year, where young researchers presented and discussed their work before a group of experts. Senior members from IUCAA, like Ranjeev Misra, Ajit Kembhavi, and several local associates of IUCAA, oversee the proceedings and mentor the youngsters. The Kerala success story continues.

There are currently three IUCAA Centers for Astronomy Research and Development [ICARD] in Kerala at Newman College, Thodupuzha, Providence College, Calicut, and the Department of Physics, Cochin University of Science and Technology [CUSAT] and local IUCAA associate coordinate the activities there.

Two astronomy workshops conducted exclusively for female students at Alphonsa College, Palai, by Minu Joy and Mar Thoma College, Chungathara, by Sheelu Abraham, have motivated many aspiring female students to take up astronomy careers. Their journey itself stood as a significant motivation factor for many.

With the retirement of many active

members from the faculty positions in the institutes in central Kerala, there has been some recent migration of activity from the central to the northern regions of the state. However, this is to be regarded only as a temporary phenomenon that would be restored when young astronomers fill the vacancies created in the universities and colleges. Ravikumar, Jeena, Sheelu, Biju, etc., from Calicut University, Blesson, Savithri, Jithesh, etc., from Christ University, Bangalore, and Titus and Charles from Cochin University are the young leaders who are taking up the baton from the seniors.

The great lesson of sharing and collaborating on research practised by astronomers from the beginning is cultivated and cherished by everyone. Thanks to the associateship program of IUCAA, retired faculty members participate in the activities and encourage and support youngsters in their ventures. These efforts have borne fruit, and currently, there are twenty Visiting Associates at IUCAA from Kerala. While concluding by thanking IUCAA for reaching out to the southernmost state in the country and meticulously following up its growth, let us hope and look forward to more fruitful years of this collaboration.

Facilities

(I) Computer Centre

The Computer Centre caters to the computing need of users from IUCAA as well as visitors from the universities and institutions around the country and abroad.

In addition to the already existing excellent computing facilities, in the past year, a computer server with 1 GB of RAM and 31 GB of hard disk was acquired to meet the expanding needs of the high end computational requirements. Four Ultra spare 10 workstations which provide high computing power have been added to the network. A printer with duplex printing capability and a CD writer have also been procured. The CD writer is greatly used by IUCAA Associates to carry their processed data and downloaded software from the internet.

Fig.3 Those who have seen only the high-performance computing power at IUCAA may have yet to realise that IUCAA also gradually grew to its present stage. The above extract from the Khagol 1999 issue may surprise some.



Fig 4. This is a 25-year-old picture showing the Mini-Workshop on Computer Astronomy participants held at Charal Mount in 1999. Sarah Ponarathnam [sitting centre] and Yogesh Wadadekar [sitting, second from left] came a couple of days before the workshop to set up about half a dozen computers for hands-on sessions and demonstrations at the workshop. Prof. SK Pandey, Ajit Kembhavi, and Late AK Kunnilethu [HoD of Physics] are sitting on the right side of Yogesh. On the right side of Sarach are G C Anupama and Annapurni Subramaniam from IIA.

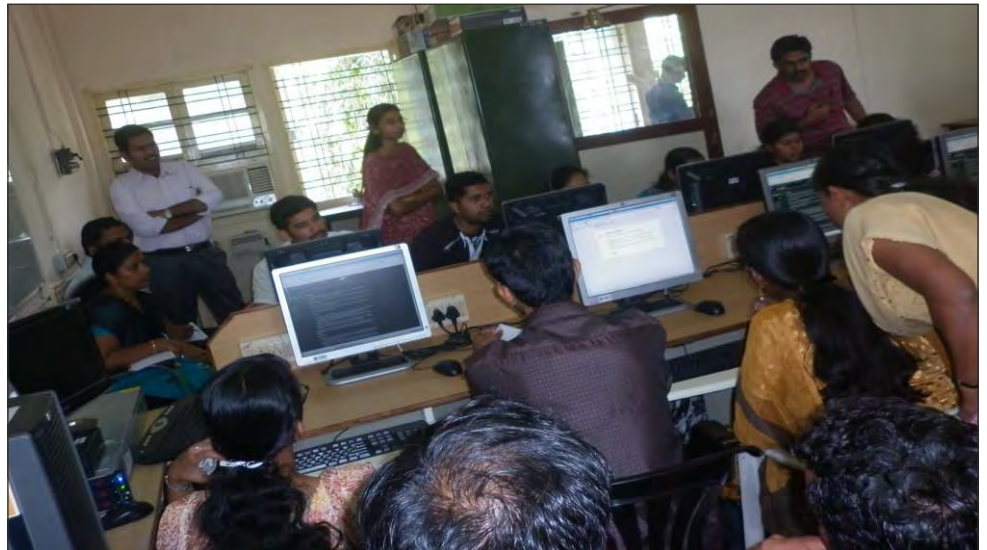


Fig 5 Conducting training programs for students was a regular activity of the IUCAA Resource Center [IRC].



Fig 6. V.C. Kuriakose and his team have conducted over a dozen telescope construction projects statewide for school students and enthusiasts.



Fig 7 During the International Astronomy Year 2009, a sequence of programs and competitions for the students in the Idukki district of Kerala under the label "Sasthagramam" was carried out by Joe Jacob and Ravi Pillai [Newman College, Thodupuzha]. The final round of twenty students who topped in these programs were brought to IUCAA, where they interacted with faculty members and research students and visited various facilities like the IGO, GMRT, etc.

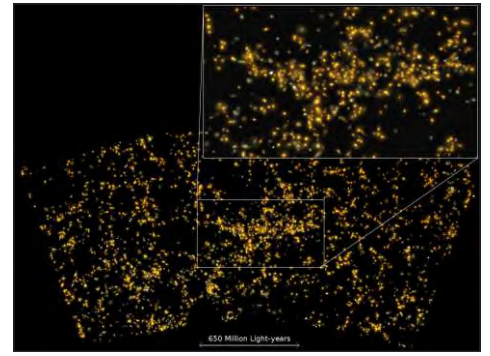
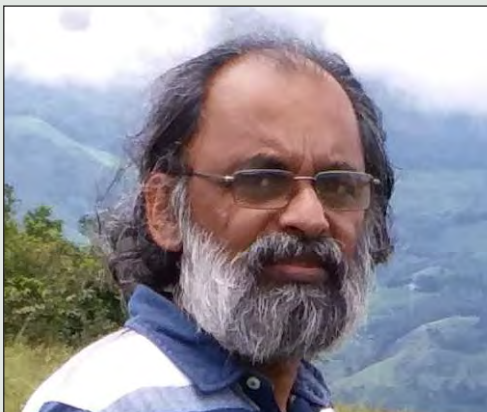


Fig 9 Many scientific contributions and discoveries have emerged from the Kerala astronomers. Notably, the discovery of the giant Galaxy Supercluster Saraswathi was spearheaded by Joe Jacob from Newman College in collaboration with Joydeep Bachi from IUCAA.



Fig 8 The Kerala astronomy activities were centred around the active involvement of the late Professor V C Kuriakose, former head of the Department of Physics, Cochin University of Science and Technology [CUSAT]



Ninan Sajeeth Philip is a visiting professor at IUCAA in his third term this year, starting in 2019. He is also a Senior Advisor to the Pune Knowledge Cluster and Director of Artificial Intelligence Research and Intelligent Systems [airis4D] in Thelliyoor, Kerala. Formerly, he taught at St Thomas College, Kozhencherry, for 33 years and is a visiting associate of IUCAA. His areas of expertise are AI and machine learning.



Indo-French Astronomy School (IFAS 8) 3D Spectro

The Indo-French Astronomy School (IFAS 8) 3D Spectroscopy was held from November 06 - 12, 2023 at IUCAA, Pune. The IFAS8 school gathered 20 student participants from different parts of India and abroad to expose them to high-level lectures on spectroscopy and dynamical modeling and proposed they carry on a week-long research project. The school was focused on "Spectroscopy and Spectrographs." It covered a wide range of topics in observational astronomy using 3D integral-field spectroscopy. One of the major highlights of the IFAS school is its intense research-based project.

IFAS8 was the 8th in the series co-organised by the Centre de Recherche Astrophysique de Lyon (CRAL), Lyon, France (LIO, CRAL CNRS UMR5574, UCBL) and Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune, India. The



school is held alternatively in Pune and Lyon. The alternation between France and India is a real added value that puts international collaboration at the centre of the school. Besides the science project, it allows cultural exchange among the participants from various places.



The school format was such that there were lectures in the morning hours, and project work started soon after lunch. The participants were mainly PhD students in their early careers and were distributed into five project groups (A, B, C, D, and E). Each group presented the outcome of their research project on the last day, with some spectacular results opening up a new perspective.

The primary characteristics of this IFAS series are:

- The high-level lectures were scheduled in the morning.
- A considerable amount of time is devoted to research projects.
- The diverse attendance, where, in particular, Indian and European students work together.



The participants were provided full boarding and lodging at the IUCAA guest house. Late-evening sessions (after the dinner) were left to the school participants' self-organisation, with encouragement to

use them to present their thesis work or research activities amongst themselves (no supervision by the professors).

Lecturer and Lecture Topics covered during the school:

Introduction to spectroscopy

Sowgat Muzahid (IUCAA, Pune, India)

Introduction to spectrographs

Ranjan Gupta

Introduction to data reduction and multi-object spectroscopy

Jens-Kristian Krogager (CRAL, Lyon, France)



Stellar spectral libraries

H. P. Singh [University of Delhi, Delhi, India]

Galaxy dynamics with IFU data

Kanak Saha [IUCAA, Pune, India]

Integral Field Spectroscopy - MUSE

Johan Richard [CRAL, Lyon, France] - Virtual

Introduction to ALMA interferometry and molecular lines

Matt Lehnert [[CRAL, Lyon, France] - virtual

Projects:

Group A: Hunting for faint and distant galaxies in near-infrared observations by VLT/SINFONI.

Tutor: Jens-Kristian Krogager [CRAL, Lyon, France]

Group B: Revealing the kinematics of galaxies using VLT/MUSE data

Tutor: Nicolas Bouché [CRAL, Lyon, France]

Group C: Exploring the circumstellar environment by direct imaging at high contrast in VLT/SPHERE-IFS 4D data cubes

Tutor: Olivier Flasseur [CRAL, Lyon, France]

Group D: Classification of Stellar Spectra using Automated Tools

Tutor: Ranjan Gupta [IUCAA, Pune, India]

Group E: Pattern speed measurement in galaxies using IFU data

Tutor: Kanak Saha [IUCAA, Pune, India]

The IFAS school has now achieved a reputation, and the organisation is running smoothly. On the last day of the school, a live feedback session was held in the presence of IUCAA director Raghunathan Srianand, CRAL director Matthew Lehnert, and other lecturers and participants. Most students were happy learning in the school, and some even continued the project work after school. The feedback from this session will be utilised to improve the next IFAS school, i.e., IFAS9, the 9th in the series to be held at Lyon, France, from 04 - 11 October 2024. The school was organised by Kanak Saha, IUCAA, Pune.

Radio Astronomy Winter School 2023

IUCAA and NCRA-TIFR jointly organised the 16th Radio Astronomy Winter School 2023 [RAWS2023] from 12th to 22nd December 2023. In its present format, RAWS invites student participants and college and university faculty members to mentor the student groups formed for the school's activities. This year, 24 student participants and seven faculty mentors participated in the programme.



The lecture sessions started with an introduction to the radio Universe and prospects, followed by single-dish radio telescopes and radio interferometry. The later lecture sessions covered radiative processes, error analysis, positional astronomy, solar radio astronomy, Aditya L1 and beyond, pulsars, millisecond pulsars and gravitational waves, radio transients, our Galaxy and its constituents, gas in galaxies, radio emission from galaxies and cosmology and its present

status, and the Giant Metrewave Radio Telescope [GMRT] and highlights of recent results.

The main emphasis of RAWS is on hands-on radio astronomy-related experiments. The participants worked in groups with their faculty mentors on experiments characterising detector noise, gain, and directionality and worked on a super-heterodyne receiver system. They determined the transmission cable

characteristics and used a horn antenna to observe the 21-cm Hydrogen emission to obtain Galaxy rotation curves. A school highlight was a day trip to the GMRT, where the participants got a guided tour of the observatory's design and functioning by Kaushal Buch, Shubendu Joarder, Subhashis Roy and Dhruva J Saikia. On the final day, the student groups presented one of their chosen experiments and competed in a game-style quiz on the topics taught in

the school.

In addition to the organisers listed below, the resource persons included Nissim Kanekar, Divya Oberoi, Bhal Chandra Joshi, Ruta Kale, Yogesh Maan and Tirthankar

Roychoudhury [all from NCRA-TIFR] and Neeraj Gupta, Dipanjan Mukherjee, Ranjeev Misra and Durgesh Tripathi [all from IUCAA]. The students and faculty's enthusiasm and active participation helped make this an enjoyable educational event. The

organising team comprised of Rajeshwari Dutta, Ashish Mhaske, Avinash Deshpande, Jameer Manur, Prakash Arumugasamy and Dhruva J. Saikia from IUCAA and Subhashis Roy from NCRA-TIFR.

Data Science in Astronomy

A meeting geared towards young researchers on Data Science in Astronomy was held from 12 to 14 December 2023 at IUCAA, Pune, to address the challenges of integrating traditional scientific domains with state-of-the-art computational techniques that revolutionise research paradigms. With its rich datasets, astronomy has already taken advantage of many machine-learning techniques and statistical methodologies, but much more can be accomplished. Ninety participants at various career stages attended the meeting.

The first day of the meeting included introductory talks about data science in Astronomy, the basics of classical machine learning, deep learning, generative models, foundation models and large language models. The meeting also included a talk on the best practices in software development and the reproducibility and interpretability of machine learning models.



The astronomical domain offers some of the most intricate and massive datasets, making it an enticing playground for data scientists looking for real-world, complex challenges. Therefore, the second day of the meeting included various science cases in astronomy which have been addressed using machine learning. These included talks related to radio astronomy, gravitational wave astronomy, galaxy morphological classification, cosmological applications, studies of stellar spectra and asteroseismology, and the Sun.

Finally, the third day consisted of a brainstorming session to develop ideas for a data hackathon. The participants were divided into groups and worked on understanding the data sets corresponding to these ideas. This allowed for networking, collaboration, and the amalgamation of ideas. The organisers believe that the meeting has helped seed collaborative projects, both short and long-term, that will continue. The meeting was organised by Surhud More, IUCAA, and Ashish Mahabal, Caltech, USA.

Statistical Techniques in Astrophysics and Cosmology Using Python

An Introductory School on Statistical Techniques in Astrophysics and Cosmology Using Python [STACUP] was organised by the Central University of Tamil Nadu [CUTN]. The school was held at Bharathidasan University, Tiruchirappalli, from 16 to 20 October 2023. The school was the second in a series of schools organised by CUTN to bolster the presence of astrophysics and cosmology research in the southern region of India.

About forty participants attended the school, with about twenty from within Tiruchirappalli and the remaining from the



other southern Indian states. The school aimed to introduce students to the fundamental concepts of statistical tools and techniques used in astrophysics and cosmology. This was achieved through lectures, hands-on sessions, and project work. The school's resource persons

included Prof. T. R. Seshadri, Dr. Sampurn Anand, and Dr. Darshan Beniwal. In addition to the technical sessions, Prof. H.S. Mani and Prof. Madhurima delivered special lectures. The students were divided into groups of 4 or 5 for the projects. The students presented the project results on

the final day of the workshop. The school was organised by T. R. Seshadri [Delhi University], V. Madhurima [Central University of Tamilnadu] and P. Muruganandam [Bharatidasam University].

ASTROCOSMOCON: Fusing Astronomy, Cosmology, and Atmospheric Research

A three-day workshop from 26-28 October 2023 sponsored by IUCAA and CCSP, SGT.

A three-day workshop on Astronomy, Cosmology, and Atmospheric research was organised from 26 to 28 October 2023 by the Centre for Cosmology and Science Popularization, SGT University, Gurgaon. The workshop was intended for the graduate and post-graduate students from India. Over three days, attendees delved deep into hands-on sessions, collaborative projects, and insightful lectures delivered by renowned experts in the field. Participants were taught the methodology for analysing the data collected from ASTROSAT. Moreover, students also learned the application of AI/ML in Astrophysics and Cosmology. Participants also got the flavour of the balloon launch program held by the Tata Institute of Fundamental Research (TIFR) and the Indian Space Research Organisation (ISRO) in Hyderabad.

On the first day of the workshop, participants celebrated the "International Moon Observation Day" and the success of Chandrayaan 3 by observing the moon and nearby objects in the sky, such as Jupiter, its moons, and Saturn, using a telescope arranged for a day from IIT-Delhi.

Thirty participants from various places in India attended the workshop. The feedback from the participants was overwhelmingly positive, with many highlighting the invaluable practical skills they acquired,



ready to be applied in their academic pursuits.

The workshop was coordinated by Aditi Agarwal [CCSP, Gurgaon] and T. R. Seshadri [University of Delhi].

Radio Astronomy Fundamentals for Engineering Students

A one-day seminar on Radio Astronomy Fundamentals for Engineering Students, sponsored by IUCAA, Pune, was jointly organised by the Department of Basic

Sciences and Humanities, Rajagiri School of Engineering and Technology (RSET), Kakkanad, Kerala, on October 28, 2023.

Approximately forty engineering students from nearby colleges representing various engineering branches attended the seminar. The event featured interactive



lectures by esteemed experts, including Neeraj Gupta [IUCAA, Pune], Joe Jacob [Newman College, Kerala], Mathew George [SH College, Kerala], and Sudheesh T P [Christ University, Bangalore]. Attendees gained valuable insights into fundamental concepts, applications, and projects like GMRT and MALS. A captivating live demonstration of Hydrogen line detection using the radio telescope at S.H. College,



Thevara, Kerala, provided by IUCAA's Teaching and Learning Centre [TLC] in Pune, further enriched the participants' experience.

Neeraj Gupta [IUCAA, Pune], Rinku Jacob [RSET, Kerala] and Joe Jacob [Visiting Associate of IUCAA and former Head, Department of Physics, Newmann College, Thodupuzha] coordinated the seminar.



North-East Meet of Astronomers [NEMA] - IX

The North East Meet of Astronomers [NEMA]-IX was conducted successfully at Mizoram University from November 20 to 22, 2023. During the three-day event, experts from all over North-Eastern states gave talks on various topics of Astronomy and Astrophysics. Participants from colleges and Universities also gave oral and poster presentations. There was an intense discussion session in which ongoing research and future research plans were discussed, along with encouragement and advice from senior scientists to the younger ones.

The event brought together researchers in Astronomy and Astrophysics from the North Eastern States to share their work and encourage each other. The event also helped in building collaborations among the researchers.

There were sixty-two participants in the event. During the event, there were eight



technical sessions with six invited speakers, twenty-eight oral presentations, and four poster presentations.

The various institutions participating in the event include Mizoram University, Tezpur University, Assam University, Gauhati University, IIT Gauhati, Dibrugarh University, RGU-Arunachal Pradesh, Cotton

College, Karimganj College, Bhawanipur Anchalik College, Moran College, Ramkrishnanagar College, IISER Kolkata and Kolasib College.

The meeting was coordinated by Lalthakimi Zadeng [Mizoram University] and Ranjeev Misra [IUCAA].

Workshop on GRAVITATIONAL WAVES and LIGO INDIA



The workshop on Gravitational Waves and LIGO India, jointly organised by the Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune and the School of Physical and Applied Sciences at Goa University, was held over five days from 27 November to 01 December 2023 at Goa University, Goa.

The workshop's primary goal was to provide participants with a profound understanding of gravitational wave physics, data analysis techniques, and instrumentation knowledge. The participants had the skills to comprehend and explore groundbreaking discoveries in this field. The workshop covered various topics, including gravitational-wave science [general relativity, source modeling, basics of search and parameter estimation], hands-on sessions on detector technologies, and data analysis tutorials. The sessions delved into the theoretical foundations and cutting-edge methodologies supporting gravitational wave research.

The workshop attracted a diverse group of forty-three participants from both the Physics and the engineering branches. Over five days, the participants engaged in comprehensive sessions that enhanced their theoretical understanding and provided them with practical skills crucial for meaningful contributions to ongoing and future research endeavours.

As part of the workshop, two enlightening public talks were organised to extend the event's impact beyond the workshop participants:

- **The Sources of Gravitational Waves by Prof. Nigel T Bishop**

Date: 28th November, Venue: Goa University

- **LIGO India Challenges and Opportunities by Prof. Sanjit Mitra**

Date: 30th November, Venue: Goa Science Centre



These public talks not only enriched the workshop participants' knowledge but also disseminated awareness and fostered public interest in the captivating field of gravitational wave physics. The workshop on Gravitational Waves and LIGO India aimed to provide participants with a holistic understanding of the subject, from theoretical foundations to practical applications. The engagement of forty-three participants from diverse academic backgrounds attested to the relevance and significance of the workshop. The public talks further contributed to knowledge dissemination, making the event impactful for participants, the wider academic community, and the public.

The workshop was coordinated by R. R. Raut [Goa University, Goa], S. Mitra [IUCAA, Pune] and A. Ganguly [IUCAA, Pune].

Meghnad Saha Memorial Workshop on Solar Astronomy focused on “Aditya -L1 Mission”

The Department of Physics, University of Allahabad, organised a three-day Meghnad Saha Memorial Workshop on Solar Astronomy focused on the Aditya L1

Mission from 04 - 06 December 2023. IUCAA, Pune, funded the workshop.

The participants comprised fifty undergraduate, post-graduate and PhD

students, including twenty students from different institutions in India and thirty student participants from Prayagraj and nearby areas. The workshop aimed to generate trained human resources for a

career in solar Physics.

The workshop began with an inauguration ceremony on 04 December 2023 chaired by Bechan Sharma, Dean, Faculty of Science, University of Allahabad and Durgesh Tripathi, IUCAA, Pune, as the Chief Guest. The inaugural function began with a welcome of the dignitaries and the lighting of the lamp, followed by Saraswati Vandana. V. K. Tiwari, Head, Physics department, gave a summary and objectives of the workshop.

The technical session on the first day was titled 'Aditya L1 mission', and Durgesh Tripathi, IUCAA, Pune, delivered a lecture on 'Solar Ultraviolet Imaging Telescope (SUIT) and other payloads on board Aditya-L1. He provided the technical details about the first Indian Solar Mission, "Aditya L1," by ISRO and encouraged undergraduate and postgraduate students to pursue a career in Solar Physics.

The second lecture by Ram Kishor, Central University of Rajasthan, Ajmer, was about the existence analysis of Lagrange Point-L1, stability analysis and possible application in different space missions. Nishant Singh, IUCAA, Pune, also gave a talk and interacted with young students attending the workshop. He discussed the fundamentals of magnetohydrodynamics, a branch of physics that deals with magnetised plasma, e.g., the Sun.

Abhishek Srivastava, IIT, BHU, began the technical session on the second day. He covered various topics, such as solar flares, CMEs, magnetic reconnection, Alfvén waves, etc. He gave an overview of both theory and observations. He discussed one of the most important problems of solar physics, namely, the solar coronal heating problem, which remains a mystery.

In his talk, Vaibhav Pant, ARIES, Nainital elaborated on CMEs evolution kinematics space weather. He emphasised the importance of studying the Sun and the role of Aditya-L1 in this regard. He provides detailed observations about the Coronal Mass Ejections [CMEs] from the launch of SOHO in 1996. Vaibhav Pant explained the CMEs as the clouds of plasma and magnetic field that are ejected from the



atmosphere of the Sun into the heliosphere, with speeds ranging between 400-2000 km/s. CMEs are mostly associated with the eruption of active region's prominences or quiescent

prominences. CMEs are the drivers of Space weather.

Alok Ranjan Tiwari, Jai Prakash Narayan University Chapra, Bihar, introduced polarimetry to measure magnetic fields in

the solar atmosphere. Prithvi Raj Singh, University of Allahabad, talked about data simulation and data collection from different data sources. He provided a detailed data analysis using different methods and software (MATLAB and Origin). He also gave Origin software and analysed data with a few techniques used by students, demonstrated the method of scientific data analysis, and showed some results.

The last day of the workshop started with a technical session based on multi-wavelength investigations of Solar Eruptive Phenomena. Upendra Kumar Singh Kushwaha explained the details of observation of the sun from the beginning to modern times. Dr. Kushwaha said that R. Carrington observed the first Solar flares on 01 September 1859 (approx 162 years ago), and on 02 September 2023, Aditya L1 was launched to study the flares in more detail.

Krishna Kumar Pandey from Bapu Intermediate College, Sadat, Ghazipur, delivered a lecture on the Evolution of the Gnevyshev gap during solar cycles. Dr. Pandey presented a long-duration behaviour of solar activity and solar cycles. Dr. Pandey explained that Solar activity has a cycle of 11 years and presented the same using a butterfly diagram. Hence, studying

the Sun is fascinating as it shows different behaviours in every solar cycle.

Bechan Sharma, Dean of the Faculty of Science, chaired the valedictory session of the workshop. Nishant Singh, IUCAA, Pune, was the Guest of Honour. Vinod Prakash graced the occasion with his presence. Several eminent speakers and workshop students shared their experiences with the workshop. Participant certificates were distributed at the end of the workshop. Upendra Kushwaha, Allahabad University, coordinated the workshop.



Beginning Astronomy v3: Start a Data-driven Journey

The Beginning Astronomy v3: Start a Data-Driven Journey was conducted from 11th to 13th December 2023 at IIT Hyderabad and was jointly hosted by IIT Hyderabad and IUCAA. BSc and BTech students in their 2nd year or higher, along with MSc and MTech students, were eligible, and 366 students applied from all over India. Forty students were selected. Dr Mayukh Pahari coordinated from IIT Hyderabad along with Dr Souradeep Bhattacharya, Dr Chayan Mondal, Dr Megha Anand, Mr Pushpak Pandey and Prof. Ranjeev Mishra from IUCAA, Pune. 13 MSc and BTech students from the Nakshatra Astronomy Club at the IIT Hyderabad were part of the Local Organizing Committee, who assisted in effective coordination.

The inauguration ceremony was followed by opening remarks from Prof. Prem Pal, Head, Department of Physics, IIT Hyderabad, along with an address by the Distinguished Guest, Prof. K Sriram, Department of Astronomy, Osmania University and Chief Guest, Dr Iswar Chandra Das, Head, Geophysics Division,



National Remote Sensing Center, ISRO, India. Prof. Shantanu Desai, Department of Physics, IIT Hyderabad, presented closing remarks. The first-day program consisted of talks on Introduction to Basic Concepts of Astronomy and Introduction to the Sun, followed by the Hands-on session on Stellar Evolution and Solar Astronomy. Prof. Shantanu Desai, IIT Hyderabad, delivered the Day 1 special talk on gravitational

waves in the nanoHz frequency regime.

The second-day proceedings started with talks on Galaxies and their evolution, an Introduction to Statistical Inference and an Introduction to Pulsar & Black Hole Astronomy. The hands-on session consisted of sessions on galaxies and statistical inference. On day two, a special evening lecture was delivered by Prof.

Gulab Dewangan, IUCAA, on the topic of data-driven, high-energy space-based astronomy.

The final day programme consisted of a hands-on session on Astronomy with Public data and Pulsar and black hole astronomy. Discussions were held on Careers in Astronomy. The renowned international scientist Prof. Renu Malhotra, University of Arizona, USA on Planetary and Lunar Science in Southern Arizona, delivered the special talk. A night sky observation session with the 14-inch telescope session was held that evening, concluding the workshop.

The primary talks were delivered by Dr Souryadeep Bhattacharya, Dr Chayan Mondal, Dr Megha Anand, Dr Pushpak Pandey and Dr Mayukh Pahari, along with one hands-on session each by Sourabh Sharma and Vishal Jadoliya, IIT Hyderabad. A workshop dinner was organised on Day 2,

promoting informal discussions. The coordinators were housed at a nearby Hotel in Sangareddy (Hotel Trishul) due to a lack of room availability in the International Guest House, IIT Hyderabad. Prof. Gulab Dewangan was provided with the only empty room at the International Guest House. Travel arrangements were made for the guests, and reimbursement for other expenses, such as dinner and travel, has been provided.

A total of 40 outstation participants were selected, 15 girls and 25 boys, along with 20 internal participants. Participants hailed from Institutions like NISER, NIT Bhopal, NIT Warangal, IISER Tirupati, IISER Kolkata, IISER Thiruvananthapuram, IISC, Osmania University, Christ University, along with institutions of Mumbai, Ahmedabad, Pune, Nagpur and Mumbai. The participants were provided accommodation at the newly-built IIT Hyderabad Hostels and free meal facilities

at the new mess. Limited travel reimbursement was provided to the participants who had submitted their GST travel bills. The participants were also provided with bags, bottles and a participation certificate on completion. The workshop LOC was always present to assist them with all their needs. The environment was such that the participants could interact freely with the workshop coordinators and were encouraged to convey negative opinions if they had any. The feedback from the participants regarding the hospitality was positive throughout. Most participants had positive feedback regarding the program, with some constructive criticism on the coding front. Almost all the participants agreed that they had a fair exposure to what sort of work is involved in data-driven astronomy. Most of them could decide whether they wanted to pursue astronomy. The internal participants were also very enthusiastic.



Welcome to...

Edmund Christian Herenz, who has joined IUCAA as the *Vaidya Raychaudhuri Post-Doctoral Fellow*

Chiranjeeb Sarkar has joined IUCAA as a *post-doctoral fellow*.

Farewell to...

Annu Jacob, **Ayan Mitra** (Rubin LSST), **Divya Rawat** (ASSC), and **Srishti Tiwari**, *Post-Doctoral Fellows* who left IUCAA at the end of their tenure or to take up a new assignment.

Parisee Shirke, *Senior Research Fellow*, who left IUCAA on completion of her term.

Professor Tanuka Chattopadhyay



The IUCAA family is saddened by the untimely passing of Professor Tanuka Chattopadhyay (née Kanjilal) on 16 October 2023, at the age of 60, after a long and heroic battle with cancer. Professor Tanuka was a Professor in the Department of Applied Mathematics at the University of Calcutta. She was earlier the Head of the Department and Dean of the Faculty of Science at Calcutta University. At her demise, she was the Director of the University's Center for Research in Nanoscience and Nanotechnology.

Professor Tanuka Chattopadhyay completed her PhD under the supervision of Professor Baidyanath Basu on the topic, 'Explosion in the central region of the Galaxy, the consequent star formation, formation of molecular clouds and structure of shocks'. With an impressive publication record, including four books and fifty papers in international journals, Professor Tanuka completed several national and international funded projects and frequently visited several leading universities in Canada, France and the USA. The results of her work have been recognised with an outstanding publication award in Astrostatistics. The implications of her research are significant for the field of astronomy and statistics. She supervised several PhD students and was a respected teacher and mentor. Professor Tanuka worked on various topics, namely, molecular clouds, star formation and density waves in the Galaxy. In later years, she worked on globular clusters, galaxies with special interest in dwarf and ultra-compact galaxies, gamma-ray bursts, statistical simulation and computation.

Professor Tanuka was a Fellow of the West Bengal Academy of Science and a member of several organisations, including the International Astronomical Union (IAU), the Astronomical Society of India, and the International Astrostatistics Association. A visiting associate of IUCAA since 2002, she was a close friend and collaborator of several IUCAA members. During her visits to IUCAA, she inspired all the students she interacted with. She is well known for her pioneering work in applying statistical methods to astronomy research and was instrumental in promoting Astronomy in Indian Universities. She will be greatly missed.

Professor Deepak B. Vaidya



The IUCAA family condoles the passing of Professor Deepak B. Vaidya, a senior physicist and an IUCAA Associate, on 23 December 2023. Professor Vaidya was a faculty member at the Department of Physics, Gujarat University, Ahmedabad, during the 1970s and 80s and was also part of the research group interested in light scattering effects of colloidal liquids. He was keenly involved in the infrared group at the Physical Research Laboratory, and he participated in several research activities undertaken by Professor J.N. Desai, including Comet Halley's observations. He worked on the modelling of dust in astrophysical environments such as the interstellar medium, comets, laboratory studies of light scattering, etc. He actively participated in several national and international meetings and workshops on interstellar dust and its modeling where all electromagnetic bands from UV, Optical and IR were covered.

An Associate during 1992 to 1998, Professor Vaidya was a frequent visitor to IUCAA for over three decades and strongly collaborated with Professor Ranjan Gupta and international collaborators from USA, UK, Germany, Russia and Japan. Professor Vaidya will be missed.

Colloquium

- 05.10.2023 Ashutosh Kotwal on **Particle physics: what we know, and what we do not know**
- 02.11.2023 Hakan Andreasson on **The weak cosmic censorship conjecture and the Hoop conjecture in the case of the axially symmetric Einstein-Vlasov system**
- 09.11.2023 Kailash Sahu on **Search and Discovery of Isolated Stellar Mass Black Holes using HST**
- 23.11.2023 Venugopal Achanta on **Metrology and Metamaterials**
- 21.12.2023K Rajibul Islam on **How to Build a Quantum Computer?**

Seminars (October 2022–September 2023)

- 12.10.2023 Nikhil Mukund on **Enabling Gravitational Wave Discoveries in the Era of AI**
- 26.10.2023 Kousik Sen on **Massive Algols as whetstones for binary star evolution towards GW sources**
- 07.11.2023 Andrés Gúrpide on **Understanding super-Eddington accretion onto Ultraluminous X-ray sources through Integral-Field Unit spectroscopy**
- 16.11.2023 Javed Rana on **The Gravitational-wave Optical Transient Observer (GOTO)**
- 28.11.2023 Vivek Kumar Jha on **Unveiling the Diverse Nature of the Inner Regions of AGNs through Variability**
- 30.11.2023 Otto Hannuksela on **Exploring gravitational-wave lensing**
- 07.12.2023 Arghyadeep Basu on **Decoding Reionization: Unraveling Impacts of Ionizing Sources through Cosmological RT Simulations**
- 14.12.2023 Mukesh Vyas on **Theory of photon scattering in shearing plasma: A novel method to produce power-law spectra at high energies**
- 19.12.2023 Kabir Chakrabarti on **The rise and the fall of Area Quantised Black Holes**

Activities undertaken by the Office of Astronomy for Education (OAE) Center India

Objective: To Professionalise astronomy education

The Office of Astronomy for Education (OAE) Center India funded the International Astronomical Union's teacher training program (TTP) selected as part of the OAE TTP 2023 on 01 and 02 December 2023 organised by the IUCAA Associate Suchetana Chatterjee together with a school teacher and a college teacher in Kolkata. Twenty-two teachers attended the workshop. The workshop included a panel discussion on modern

pedagogical techniques, a talk on current developments in Astronomy, and the usage of modern astronomy software tools, followed by a telescope observing session.

Objective: Provide access to good resources

Resource Translations

OAE Center India coordinated the completion of the Hindi translations of the Big Ideas in Astronomy book, which focuses on astronomy literacy for all and is

working on the Marathi and Malayalam translations next.

New resources

The OAE Center India has finished compiling a booklet of positional astronomy-related articles from an HBCSE magazine, 'Anandi', in the local vernacular language, Marathi. The booklet contains short science articles catered to students' academic and emotional needs, introducing science topics through creative stories. These were thoroughly

internally reviewed by the OAE Center India for accuracy and simplicity. The OAE Center plans to translate the booklet articles into English and later into other languages. The current copy can be accessed here. <https://astro4edu.iucaa.in/books.html>

The OAE Center is in the process of finalising solar system theme-based Astronomy glossary cards for printing.

The OAE Center India team has helped to move the Romanian, Chinese, and Haitian translations of the Big Ideas book into the inDesign form suitable for printing.

The OAE Center India personnel at HBCSE have actively produced a series of

educational videos in astronomy, each approximately 12 to 15 minutes, to make foundational astronomy concepts more accessible. These videos span topics from the solar system to celestial coordinates and magnitudes, catering to high school and early undergraduate students and educators in English and the local languages, Hindi and Marathi. During this quarter, several episodes were in the post-editing stage, with the YouTube premiere planned for early January 2024. The initiative will be supported by promotional efforts on OAE's social media channels, aiming to broaden the reach and impact of astronomy education through digital mediums.

Objective: Promote astronomy in curricula

Baseline Survey

The OAE Center India has conducted a baseline survey for the status of astronomy education throughout the country over the last year. Over 2000 students from 34 schools in 10 states participated in the survey. The analysis of the survey shows that although students are highly interested in astronomy, most need to gain adequate knowledge of basic astronomy. The research explored how gender, availability of resources, and geographic variation affect these conclusions in any way. A manuscript based on these results will be sent for peer review.

Astronomy Centre for Educators

Malaviya Mission Teacher Training Centre

Pedagogic Workshop on Astronomy, Astrophysics and Cosmology

A five-day workshop titled “Pedagogic Workshop on Astronomy, Astrophysics and Cosmology” was organised from 6th – 10th November 2023 for teachers teaching astronomy and astrophysics to undergraduate students in the northern part of India. The workshop was jointly organised by the Astronomy Centre for Educators, Malaviya Mission Teacher Training Centre, IUCAA, Pune and Physics Department, St. Stephen's College, University of Delhi, at St. Stephen's College. Around 30 teachers and 15 resource persons attended the workshop.

The Principal of St. Stephen's College inaugurated the workshop, and Dipankar Bhattacharya, Ashoka University, delivered the inaugural lecture. The main purposes of the workshop were to [i] explore innovative teaching methodologies and strategies that can improve student learning experiences in the field of astronomy and astrophysics, [ii] expand subject knowledge of key concepts in core areas of astronomy, astrophysics and cosmology, [iii] develop resource materials that teachers can utilise to enhance their instructional practices and engage their students effectively, and [iv] equip



teachers with practical tools and hands-on activities that they can implement in their classrooms, fostering active learning and critical thinking among students. The topics covered included stars and stellar evolution, multi-messenger astronomy, astronomical experiments, galaxies and active galactic nuclei, x-ray astronomy, pulsars and radio astronomy, dark matter, cosmic distance ladder, and cosmology. There were hands-on sessions every day and presentations by the teacher participants. The resource persons were Dipankar Bhattacharya and Philip Cheria

[Ashoka University], T. R. Seshadri and Darshan Beniwal [Delhi University], Aru Beri [IISER Mohali], Chetana Jain [Hansraj College], Suprit Singh [IIT Delhi], Main Pal [Sri Venkateswara College], Deepak Jain [Deen Dayal Upadhyaya College], Geetanjali Sethi, Akshay Rana, Shruti Thakur and Sanil Unnikrishnan [St. Stephen's College] and Prakash Arumugasamy and Dhruva J. Saikia [IUCAA]. The coordinators of the workshop were Geetanjali Sethi, St. Stephen's College, University of Delhi, Vaidehi S. Paliya, IUCAA, Pune, and Team ACE, IUCAA.

National Education Policy (NEP) Orientation and Sensitization Programme

The NEP Orientation and Sensitization Programme under the Malaviya Mission Teacher Training Programme was conducted online from 1st to 10th November 2023. The resource persons included Malhar A. Kulkarni, Cell for Indian Science and Technology in Sanskrit, who spoke on Indian Knowledge Systems; Malish C. M., Ashank Desai Centre for Policy Studies, who spoke on Student Diversity and Inclusive Education; Milind Sohoni, Centre for Technology Alternatives for Rural Areas and Anush Kapadia, Department of Humanities and Social Sciences, both of whom spoke on Higher Education and Society; Sarmistha Pattanaik, Department of Humanities and Social Sciences, who spoke on Research and Development. They are all from IIT Bombay.

Narayan Sharma, Cotton University, and Aniket Sule, Homi Bhabha Centre for Science Education, spoke on Holistic and



Multidisciplinary Education; Garima Malik, National Institute of Educational Planning and Administration and Dhruba J. Saikia, IUCAA, spoke on Academic Leadership, Governance and Management. Bhupendra N. Goswami, Cotton University, spoke on Research and Development; Yogendra Pal, NIIT University, on Information and

Communication Technology for higher education, while Santosh Mehrotra, Jawaharlal Nehru University discussed Skill Development. The Programme was attended by about 30 participants, who each wrote two essays on any two of the presentations as part of their evaluation.

Public Outreach Activities

50th Rashtriya Bal Vaigyanik Pradarshani (RBVP) 2023:

The IUCAA Inter-University Centre for Astronomy & Astrophysics Scipop team had put up a stall at RBVP from 26 to 31 December 2023. Posters mentioning information about IUCAA and its academic activities were displayed. Astronomy Concept models and our iconic "Velo-Gyaneshwari" bicycle, which consists of 40 hands-on experiments, were also displayed. A telescope made at the IUCAA was displayed as a part of the IUCAA Telescope-making workshop. A sky-observation session was conducted with Pimpri Chinchwad Science Park for around 500 RBVP attendees. We received many visitors, approximately 20,000 students from 200 Schools with 1000 teachers and 3000 general Public.

Science Toys Demonstrations and Basic Astronomy Sessions

5th October: Dyanaganga Vishwa Vidyalaya, Shirur, Pune, 100 students, five

teachers, conducted by Prasad Adekar and Shivani Pethe.

10th October: Tara Mobile Creche, Pune, 40 students, four teachers, conducted by Shivani Pethe.

12th October: Balavantrao Zele School, 50 students, five teachers, conducted by Rupesh Labde.

17th October: Manvya Sanstha, Kothrud, 25 students, five teachers, conducted by Prasad Adekar.

17th October: Dattakala Shikshan Sanstha Daund, 104 students, 12 teachers, conducted by Rupesh Labde.

19-20 October: Ryan International School, Bhavdhan Pune, 145 students, ten teachers, conducted by Rupesh Labde.

26th October: Dapodi Kanya Shala No. 31, Dapodi Pune, 85 students and four teachers, conducted by Shivani Pethe.

21st November: Vibgyor Rise, Chinchwad, 45 students, two teachers, conducted by

Rupesh Labde.

23rd November: New English School, Landewadi, 100 students, six teachers, conducted by Prasad Adekar and Rupesh Labde.

7th December: St Mary's College Thoothukudi, Tamil Nadu, 44 students, six teachers, conducted by Prasad Adekar.

12th December: Bhartiya Jain Sanghata School, Wagholi, 90 students, three teachers, conducted by Rupesh Labde.

19th December: Saraswati Vishwavidyalay, Talwade, 60 students, three teachers, conducted by Rupesh Labde.

21st December: Tara Mobile Creche, 90 students and three teachers, conducted by Shivani Pethe.

22nd December: Dnyanganga Vishwavidyalaya Shirur, 150 students, ten teachers, conducted by Rupesh Labde and Tushar Purohit.

28th December: Chandranarayan Balwade English School, Jaysingpur, 88 students and eight teachers, conducted by Prasad Adekar.

Teacher Training:

6th November: Agastya International Foundation, Baramati, 80 teachers, conducted by Rupesh Labde.

14th December: SVS High School, Khadi, 300 teachers, conducted by Rupesh Labde.

Telescope Making Workshop:

22nd December: A telescope-making workshop was conducted by Tushar Purohit and Maharudra Mate for

participants from IIT Gandhinagar.

Regular Friday Skywatching sessions saw an attendance of 150, while a special sky session organised for Foundation Day had about 200 people enjoying viewing the sky with telescopes.

2nd Saturday lectures:

14th October: "Formation of Black Holes" by Prof. Surhud More [Marathi] and Dr. Moupiya Maji [English].

11th December: "Detecting the Invisible through Gravitational Waves" by Dr. Pushpa Khare [English and Marathi].

Public Talks in Chandrasekhar

Auditorium:

13th December: A Public lecture was organised by IUCAA Scipop on "ZARTH: How to catch a Supernova". The speaker was Dr. Ashish Mahabal.

29th December: The 35th IUCAA Foundation Day Lecture titled "Innovate to Transform" was delivered by Padma Bhushan Prof. Jyeshtharaj Bhalchandra Joshi, a well-known chemical engineer and nuclear scientist.

Visitors

Visitors [October – December 2023]

Venu Gopal Achanta, Sajad Ahmad Ahanger, Somi Aktar, Spoorthi Ambore, Per Hakan Magnus Andreasson, Simran Arora, Mayukh Bandyopadhyay, Uddipan Banik, Bhaskarjyoti Barman, Quentin Basto, Prasad Basu, Aru Beri, Piyali Bhar, Atul Bhat, Suman Bhattacharyya, Sree Bhattacharjee, Nigel Bishop, Mohit Singh Bisht, Promila Biswas, Ritabrata Biswas, Samrat Biswas, Himanshu Bora, Hritwik Bora, Mary Bosco, Sukanta Bose, Nicolas Bouche, Koushik Chakraborty, Subenoy Chakraborty, Sumanta Chakraborty, Kabir Chakravarti, Komal Chand, Suresh Chandra, Madhura Chattopadhyay, Suchismito Chattopadhyay, Surajit Chattopadhyay, Ankita Chaudhary, Amal George Cheriyan, Anirban Chowdhary, Tanmoy Chowdhury, Amit Das, Sampriya Das, Shyam Das, Sayak Datta, Renu Devi, Sumit Dey, Ruchika Dhaka, Shankar Dhar, Payaswinee Dhoke, Roshan Kumar Dora, Reetika Dudi, Broja Gopal Dutta, Olivier Flasseur, Gaurav Gadbail, Shashank Gairola, Anoop Gavankar, Tuhina Ghorui, Moli Ghosh, Sayan Ghosh, Shounak Ghosh, Sushant G. Dhritimaan Gogoi, Aruna Govada, Mehul Goyal, Sagar Singh Goyary, Ambey Gupta, Ranjan Gupta, Soumya Gupta, Andres Gorpide, Prabir Kumar Halder, Otto Hannuksela, Srijita Hazra, Jyotishree Hota, Nazma Husain, Kazi Rajibul Islam, Joe Jacob, Ankita Jangid, Vivek Kumar Jha, Hira Joshi, Manish R. Joshi, Sunil Joshi, Akhila K., Md. Mehedi Kalam, Vishal Kale, Sammi Kamal, Kartav Kesri, G.S. Khadekar, Katrien Kolenberg, Dawood Kothawala, Ashutosh Kotwal, Jens-Kristian Krogager, Sayali Kulkarni, Aman Kumar, Rajesh Kumar, Parthkumar Kumbhani, Ioannis Kyriotakis, H. Lalthantluanga, Ashish Mahabal, Sunil Maharaj, Soumak Maitra, Prajjwal Majumder, Soma Mandal, Prajakta Mane, Manoj Kumar Manuj, Helen Mason, Andrew Lawrence Miller, Asitang Mishra,

Bibhuprasad Mishra, Swagat Mishra, Sajahan Molla, Soumen Mondal, Nikhil Mukund, Masum Murshid, Fathimath Shifa N.K., Hemwati Nandan, Supriya Narayan, Brian O'reilly, Sachin P.C., Shibesh Kumar Jas Pacif, Sreejith Padinhatteeri, Indrani Pal, Divya Pandey, Subhasis Panja, Manu Paranjape, K.D. Patil, B.C. Paul, Geetha Paul, Devraj Pawar, D.V.S. Phanindra, Ninan Sajeeth Philip, Ananta Charan Pradhan, Anirudh Pradhan, Arbind Pradhan, Jiji Pulikkotil, Naeem Ahmad Pundeer, Farook Rahaman, Aparna Raj, Harini Rammohan, Javed Rana, Chayan Ranjit, Sujata Kundu Ranjit, B.S. Ratanpal, Ashmita Roy, Atish Roy, Bikash Chandra Roy, Prabir Rudra, Amrutha S., Nagabhushana S., Rajesh S.R., Pradyumn Kumar Sahoo, Kailash Sahu, Eeshankur Saikia, Sahil Saini, Guru Janbhoshwar, Bidisha Samanta, Arijit Sar, Banibrata Sarkar, Seema Satin, Yash Saxena, Koushik Sen, Anand Sengupta, Rikpratik Sengupta, Ranjan Sharma, H.P. Singh, Pratyush Singh, Priyanshu Singh, Swapnil Singh, T.P. Singh, Tanish Singla, Abisa Sinha, Sekhar Sinha, Raja Solanki, Ashima Sood, Sanjeeda Sultana, Ami Tank, Javaid Ahmad Tantray, Anamika Tiwari, Charis Tsakonas, Shafqat Ul-Islam, Nilkanth Dattatray Vagshette, Murli Manohar Verma, Mukesh Kumar Vyas, Chandan Watts, Neha Yadav, Andrzej Antoni Zdziarski, Rashmi.

Visitors [Expected]

January 2024

Deepali Agarwal, Universite Catholique de Louvain, Belgium; G. Ambika, IISER Trivandrum; Kewal Anand, Indian Institute of Technology, Kanpur; Simran Arora, Central University of Himachal Pradesh, Himachal Pradesh; Swetha Bhagwat, University of

Birmingham, United Kingdom ; Parag Bhattacharya, Rangapara College, Assam; Gautam Bhuyan, Cotton University, Assam; Sajad Ahmad Boked, University of Kashmir, Srinagar; Christian Braun, Toptica Photonics AG, Germany; Hum Chand, Central University of Himachal Pradesh, Himachal Pradesh; Bhag Chand Chauhan, Central University of Himachal Pradesh, Himachal Pradesh; Pravat Dangal, St. Joseph's College, Darjeeling; Athar Ahmad Dar, University of Kashmir, Srinagar; Sikandar Akbar Dar, University of Kashmir, Srinagar; Mami Deka, Cotton University, Assam; Dharmender, Central University of Himachal Pradesh, Himachal; Jibitesh Dutta, North -Eastern Hill University, Shillong; Amar Nath Gupta, M/s Simco Global Technology and Systems Ltd, Delhi; K.P. Harikrishnan, No affiliation; Sameer Jadhav, DCSEM, Mumbai; Sammi Kamal, Jamia Millia Islamia, Delhi; Shivam Kumar, IISER, Tirupati; Jeremie Lasue, Observatoire Midi-pyrénées, France; Mehak Mahajan, University of Himachal Pradesh, Shimla; K Mahapatra, DCSEM, Mumbai; Siddharth Maharana, South African Astronomical Observatory, South Africa; Prakhar Maheshwari, IIT, Madras; Manikandan, Institute of Mathematical Sciences, Chennai; Priya Mehra, Central University of Himachal Pradesh, Himachal Pradesh; Subroto Mukherjee, Institute of Plasma Research, Ahmedabad ; Shankar V. Nakhe, RRCAT, Indore; Anand Narayanan, IISST Trivandrum; Varuni P., Institute of Mathematical Sciences Chennai; Archana Pai, IIT, Powai; Dushmantra Patra, S.N. Bose National Centre for Basic Sciences, Kolkata; Ninan Sajeeth Philip, ARIS, Kerala; Anil Prabhakar, IIT, Chennai; Ram Prasad Prajapati, Jawaharlal Nehru University, New Delhi; Vishal Upendran, Lockheed Martin Solar and Astrophysics Lab, USA; Niruj Mohan R., Indian Institute of Astrophysics, Bangalore; Sendhil Raja, RRCAT, Indore; Pranjal Ralegankar, SISSA, Trieste, Italy; Shrey Ramanujam, IIT, Madras; Arshi Rastogi, University of Manchester, United Kingdom; Abhinaba Saha, IISER, Tirupati; Sandesh Salunke, S.P. Pune University, Pune; Shiv Sethi, Raman Research Institute, Bangalore; Zahir Shah, Central University of Kashmir, Kashmir; Mohd. Shahalam, Integral University, Lucknow; Gauri Sharma, University of Western Cape, South Africa; Paryag Sharma, Central University of Himachal Pradesh, Himachal Pradesh; Vaibhav Sharma, IIT, Kanpur; Pratyush Singh, BITS-Goa; Ami Tank, St. Xavier's College, Mumbai; Arman Tursunov, Max Planck Institute for Radio Astronomy, Bonn, Germany.

February 2024

Shahzada Akhter, Islamic University of Science and Technology, Jammu and Kashmir; Anjum, Islamic University of Science and Technology, Jammu and Kashmir; Satadru Bag, Technical University of Munich, Germany; Suman Bala, Science and Technology Institute, USA; Tabasum Mastood Bhat, Government College for Women, Srinagar; Hritwik Bora, Tezpur University, Assam; Suraj Kumar Chaurasia, Banaras Hindu University, Varanasi; Siddhartha Gupta, Princeton University, USA; H. Lalthantluanga, Mizoram University, Mizoram; Kushal Lodha, Korean Astronomy and Space Institute, South Korea; Surajit Paul, Manipal Academy of Higher Education, Manipal; Subharthi Ray, University of Kwazulu-Natal, South Africa.

March 2024

Pranjudipriya Goswami, University of Paris, France; Rinku Jacob, Rajagiri School of Engineering and Technology, Kerala.

Long Term Visitors

- Avinash Deshpande RRI, Bangalore (Visiting Professor)
- David Hilditch, University of Lisbon, Portugal. (Adjunct Faculty)
- Ashish Mahabal, CALTECH, USA. (Adjunct Faculty)
- Somak Raychaudhury, Ashoka University, Haryana (Adjunct Faculty)
- T. P. Singh, Ex- TIFR, Mumbai (Visiting Professor)
- Shamin Padalkar, (Honorary Visiting Position)

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