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# KHAGOL

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**Editor :**
**Aseem Paranjape**
(aseem@iucaa.in)

**Editorial Assistant :**
**Manjiri Mahabal**
(mam@iucaa.in)

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## Thirty-First Foundation Day Lecture

The 31st IUCAA Foundation Day Lecture was delivered on 29 December 2019 by Dr. K. VijayRaghavan, FRS, Principal Scientific Adviser to the Government of India. An alumnus of IIT, Kanpur and TIFR, Mumbai, Dr.VijayRaghavan is a distinguished professor in the field of developmental biology, genetics and neurogenetics. In an illustrious career spanning more than 30 years, Dr.VijayRaghavan has served in a number of important positions including Director of the National Centre for Biological Sciences (TIFR), in whose establishment he played an instrumental role, Secretary of the Department of Biotechnology, India, and most recently as the Principal Scientific Adviser to the Government of India.

Amongst his many awards and honours are a Fellowship of the Royal Society, the Bhatnagar Prize for Science and Technology awarded by the Council of Scientific and Industrial Research, India, and the Padma Shri awarded by the Government of India.

The Lecture was titled ***'Manthan: The promises and perils of the churning of data'*** and dealt with the myriad questions and challenges facing human society in an age where the processing of information of all kinds is being handed over to increasingly complex machines or artificial intelligence (AI).


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Dr.VijayRaghavan posited that 'knowledge has always been the key that opens the door to power, but today fewer and fewer people share that key'. In this backdrop, he first guided the audience through a number of basic concepts in computing and data science and how these impact human existence. He emphasised that raw data is distinct from information, which itself must be converted to knowledge in order to be relevant. Finally, only when knowledge is transformed to understanding in a broader conceptual framework does it lead to reasoned action.

Next, Dr.VijayRaghavan gave a fascinating overview of the origins of human intelligence, pointing out that our current levels of intelligence are largely the consequence of a series of cosmic accidents starting from the extinction event that wiped out the dinosaurs and allowed mammals to flourish, to the emergence of the opposable thumb, the invention of fire and subsequently the development of a relatively oversized brain. All of this has led to humans becoming extraordinary engineers of nature and now, with the advent of AI, entering the age of 'Big Data' where data is generated and processed at 'warp speed'. In this context, Dr.VijayRaghavan argued that we must be cautious to interrogate all data to ensure its ethical provenance before using it to our benefit. The vastness of the data sets now available for various purposes also means that the conversion of data into understanding is an increasingly challenging task. One must also guard against the threat of the misuse of data to disempower classes of society by denying them access to the fruits of this data. The road forward for India, he argued, must involve spreading awareness and understanding of what lies behind the complexities of big data, by educating our youth in the fundamentals of mathematics and computer science. The Lecture ended with a lively discussion with audience.

## New Core Faculty for IUCAA

*Contd. from page 1*

### Subhadeep De

Subhadeep De, who has joined IUCAA in December 2019 as a faculty member (Associate Professor), obtained his PhD on Laser Cooling and Trapping of Barium, in 2008 from the University of Groningen, The Netherlands. He worked as a post-doctoral research associate during 2008-2012 at the Joint Quantum Institute, Maryland, USA, which is a joint institute between National Institute of Standards and Technology, Gaithersburg, and University of Maryland. He worked on Degenerate Mixtures of Bose and Fermi Gasses. Since 2012 until he joined IUCAA, Subhadeep De was a faculty member at the CSIR-National Physical Laboratory, New Delhi, where he was developing optical atomic clock for time and frequency metrology. His research interests are precision measurements for fundamental studies and developing quantum enhanced technologies for quantum information processing. For this purpose, he is on the process of setting up an advanced Atomic-Molecular-Optical experimental facility at IUCAA namely, Precision and Quantum Measurement Lab.

### Dipanjan Mukherjee

Dipanjan Mukherjee, who has joined IUCAA in December 2019, as a faculty member (Assistant Professor), did his PhD at IUCAA in 2014, on Magnetic Field Structures on Accreting Neutron Stars. Then he was a post-doctoral fellow at the Research School of Astronomy and Astrophysics, Australian National University, Canberra, on Simulations of Relativistic Jets from Super-massive Blackholes and their Impact on Galaxies, and followed by another post-doctoral position at the University of Torino and the Observatory of Torino, Italy, on Simulations of Relativistic Jets and their Emission Processes. His broad areas of research interest are: Topics of high energy astrophysics and simulations of astrophysical fluids over a diverse range of scenarios. A strong emphasis is on developing numerical techniques to be used in large scale simulations, which are then compared with observational data. Some of the current topics of his interest are: Galaxy evolution over cosmic time and the impact of outflows from supermassive blackholes, physics of relativistic jets from blackholes of all scales, and physics of accreting compact objects such as neutron stars and stellar mass blackholes.

# Astronomy Centre for Educators


**Inauguration of the Building**

A significant event during this year has been the inauguration of the Teaching Learning Centre (TLC) building by K.VijayRaghavan, Principal Scientific Adviser to the Government of India on December 29, 2019, which was also the Foundation Day of IUCAA.

The building consisting of three floors (G+2) with a total built-up area of 7,232 sq. ft., has a smart classroom, a recording room, a computer centre, two experimental laboratories, one dark room, a small auditorium, a telescope making laboratory, an observatory on the terrace, and common and office spaces.

The pictures here show the inauguration of the building, a view of the building, and interaction of K. VijayRaghavan with IUCAA staff.

The building has been financed by the Ministry of Human Resources Development under the PMMMNMTT Scheme.

## Welcome to...

### Avyarthana Ghosh

Avyarthana Ghosh, who has joined IUCAA in November 2019 as a Post-doctoral Fellow, under the SUIT project. She has finished her PhD from the Centre for Excellence in Space Sciences in India, IISER, Kolkata in 2019. She has, however, been a part of the IUCAA fraternity for a long time, because her PhD thesis has been under the mentorship of Durgesh Tripathi and A. N. Ramaprakash of IUCAA. She has been working actively on designing and performance modelling of the Solar Ultraviolet Imaging Telescope (SUIT), a payload on-board ISRO's Aditya-L1spacecraft. SUIT focusses on observations of features in the lower solar atmosphere along with the eruptive events and space-terrestrial climate with high cadence and spatial resolution.

The work includes designing of filters for the telescope, which ensures optimized performance. Detailed work on the imaging and photometric performance modelling as well as the failure modes effects analysis of the instrument were also undertaken during her PhD tenure. These could, eventually, serve as abase for future space-based missions in similar wavelength domains of the electromagnetic spectrum. In parallel, she has been working on observational studies, involving both imaging and spectroscopy of the Sun's atmosphere with existing space-based data. While the results of some of these studies lead to understanding the dynamics and plasma conditions in the intermediate and upper solar atmosphere, some serve as examples of the data that is expected from SUIT in future. Therefore, her work is an amalgamation of observational analysis along with the designing of a future imaging telescope. Combined observations from such existing and upcoming facilities will give a comprehensive understanding of the physical processes and dynamic coupling of plasma and energy in similar stellar atmospheres.

She recently has won the K. D. Abhyankar Best Thesis Presentation award at the 38th meeting of the Astronomical Society of India. She aims at extending her research in other domains of astronomical instrumentation in future, along with her current interest in observational studies.

## Congratulations to...

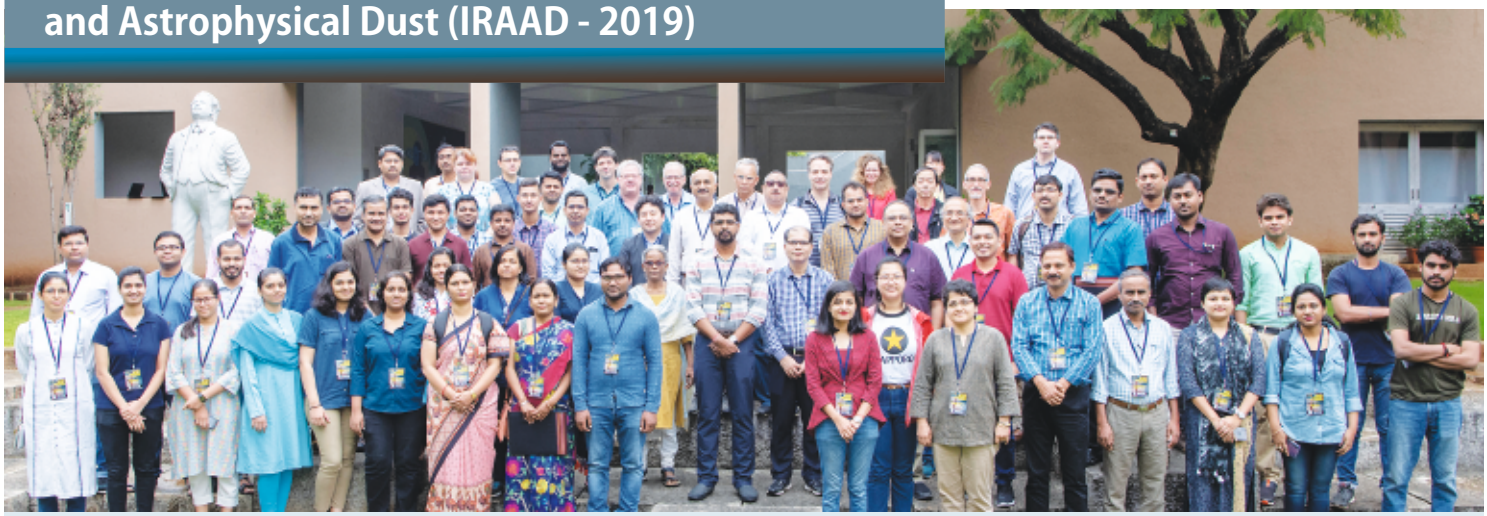
**Ajit Kembhavi** (IUCAA), and **Pushpa Khare** (Former Visiting Associate of IUCAA, from the Department of Physics, Utkal University, Bhubaneswar) for being the recipients of the award ***"Mahatma Jyotirao Phule Puraskar" (2018),*** for their Marathi book: Guruttviy Tarang-Vishwdardshnache Nave Sadhan (Gravitational Waves - A New Tool to Watch and Understand Universe), by the Maharashtra Rajya Sahitya ani Sanskruti Mandal, under the category of 'Science and Technology (including Computer and Internet)'.

This award has been given by the Government of Maharashtra, under ***'The Late Yashwantrao Chavan State Literature Award Scheme'.***

## Farewell to...

**Sargam M. Mulay,**
who has joined the University of Glasgow, UK, as a Research Assistant.

## International Conference on Infrared Astronomy and Astrophysical Dust (IRAAD - 2019)



The IRAAD - 2019 was held at IUCAA during October 22-25, 2019, and was attended by about 15 foreign participants from Japan, France, Russia, USA, and Canada. There were about 70 participants from India, and were mainly PhD Students, Post-doctoral Fellows, and Faculty from Indian Institutes (IUCAA, IIA, TIFR, ARIES, SNBSC, ICSP,PRL, IIIST, etc.), and several Indian Universities (Gorakhpur, Assam, Tezpur, Mahatma Gandhi, Baroda, etc). The broad topics covered were: ISM Overview - Phases and Constituents, Infrared Astronomy - Techniques and Diagnostics, Dust in ISM - Composition, Starlight Extinction - Observations and Models, ISM Molecules and Spectroscopy, Star Formation - The Role of the ISM, Dust and Molecules in External Galaxies, and Laboratory Astrophysics, Astrochemistry and Quantum Chemistry.

There were 14 review talks, 27 contributory talks, and 28 posters. The posters summary was reported by Jan Cami and Els Peeters, and the overall conference summary was made by Eric Herbst. Ranjan Gupta (IUCAA), and Shantanu Rastogi (Gorakhpur University) were the coordinators of this conference.

## Second Indo-Chile Astronomy Dialogue

The 2nd Indo-Chile Astronomy Dialogue was organized at IUCAA, during December 3 – 5, 2019.

There were 30 participants, attended in person, and through Skype. The speakers were: H. E. Juan Angulo (Chilean Ambassador, New Delhi), G.C. Anupama (IIA, Bengaluru), Joydeep Bagchi (IUCAA), Himadri S. Das (Assam University, Silchar), Abhirup Datta (IIT, Indore),Cristian Davies (Political and Economic Affairs, Chilean Embassy, New Delhi), Marcos Diaz (Space and Planetary Exploration Laboratory, Universidad de Chile, Santiago),Yashwant Gupta (NCRA, Pune), Priya Hasan (Maulana Azad National Urdu University, Hyderabad), NissimKanekar (NCRA, Pune), Jayant Murthy (IIA, Bengaluru), Cesar Ocampo (Atacama Astronomical Park, Santiago), D .K. Ojha (TIFR, Mumbai), Amitesh Omar (ARIES, Nainital), and Eduardo Unda Sanzana (Centro de Astronomia, Universidad de Antofagasta, Chile).

The participants including the ones on Skype presented talks on wide areas on the status of Radioand Optical Astronomy in both the countries. During the last day of the dialogue, the following points have been agreed by both the sides:

1. Possibility of installing a small radio and optical telescope at a suitable site in Chile,

which can be remotely operated by Indian astronomers.

2. Both countries, being on almost 12 hours

longitudinal separation, can use mutually agreed telescope time sharing to their advantage.

3. Both countries have their expertise on astronomy instrumentation(astro-engineering), and this can be shared; e.g., India can provide know-how or build optical/radio instruments for the respective telescope and similarly from Chilean side.

4. In areas of space, joint small satellites development and launch by ISRO to be pursued.

5. India has an established balloon programme for astronomy, and can provide common collaboration in terms of building balloon based payloads and launches, etc.

6. Explore interchange of staff/students between participating institutions, or between these and universities, taking advantage of the existing regulatory frameworks allowing these mechanisms. If possible, execute MoUs in the same.

7. The Astronomical Society of India (ASI) will make a working committee to pursue the various aspects of this dialogue's action items, and it will also formulate an expression of interest (EoI), which will be circulated to the ASI members for their response.

*The dialogue was coordinated at IUCAA by Ranjan Gupta.*

## Newton - Bhabha: Open Data (Indo - UK) Workshop

The joint Indo – UK Newton – Bhabha: Open Data Workshop was held at IUCAA during December 4-6, 2019. The main goal was to provide an opportunity for students, postdocs and other academics interested in gravitational waves, and who would look forward to do science with the LIGO-India Observatory. There were 60 participants.

The resource persons were the experts from the UK, such as Giles Hammond, Martin Hendry, Chris Messenger, and Ik Siong Heng. There were several Indian and foreign other experts in experimentation /instrumentation as well as those from gravitational wave science and data analysis. The format of the workshop included a few common sessions and many parallel sessions. For the Open Data part of the workshop, there were hands-on tutorial sessions on Basics of GW data, Application of deep learning to classify BBH signal vs. Noise and a non-standard yet improved data analysis pipeline. In parallel, we had the experimental sessions, where the groups working on LIGO coatings research and cryogenic suspension technology talked about the stringent requirements and timelines that they face with the next generation interferometric detectors. They pointed out key research

areas, where Indian research community can get involved. Members of LISC and LI-TRD explained the urgent need for trained manpower with the upcoming LIGO - India Observatory, and the possible solutions to problems in next generation LIGO controls. In addition to EPO efforts, scope and collaboration with LI-EPO were also discussed in the workshop. The organising committee was co-chaired by Anupreeta More, and Manasadevi Thirugnanasambandam (both from IUCAA).

## Workshop on General Relativity and Cosmology

The Department of Mathematics, Institute of Applied Sciences and Humanities, GLA University, Mathura, in collaboration with IUCAA, organized the Workshop on General Relativity and Cosmology, during October 11 – 13, 2019. There were 41 participants, including 25 research scholars and 10 MSc students of physics and mathematics from all over the country, and 6 faculty members from GLA University. The primary attraction of this workshop was Padma Vibhushan and Bhatnagar award winner Jayant Narlikar, who in his talk explained how cosmology was a part of star gazing where numerous things identified with the universe could be examined. He, using test strategies, demonstrated a strong possibility that we were not alone in the universe. Narlikar reignited the passion to learn and investigate more about galaxies, blackholes, stars and universe at large among the research scholars. He guided them by clarifying their doubts and explaining complex ideas, and encouraged them to continue their research in this field.

The resource persons of this workshop were: Sushant Ghosh (Jamia Millia Islamia, New Delhi), G. K. Goswami (NSUT, New Delhi), Charles Jose (CUSAT, Kochi), and Dawood Kothawala (IIT - Madras, Chennai). The lectures were on general topics of relativity and cosmology. At the end of the workshop, the Vice-Chancellor of GLA University, A. M. Aggarwal, felicitated Narlikar and Mangala Narlikar by giving mementos. The participants adulated the workshop in their feedback, and affirmed that the knowledge and experience gained in these three days would keep enriching their research work in future.The workshop was coordinated by Aseem Paranjape (IUCAA) and Anirudh Pradhan (GLA University).

## Workshop on Emergent Gravity Paradigm

The Workshop on Emergent Gravity Paradigm was held at the Department of Physics, Cochin University of Science and Technology (CUSAT), Kochi, during November 8 – 10, 2019. The focus was the theoretical foundations of gravity as an emergent phenomenon. The workshop was inaugurated by K. N. Madhusoodhanan (Vice-Chancellor, CUSAT), and it began with an introductory lecture by T. Padmanabhan (IUCAA). Other lectures were given by Dawood Kothawala (IIT – Madras, Chennai), Kinjalk Lochan (IISER, Mohali), Sumanta Chakraborty (IACS, Kolkata), Karthik Rajeev (IUCAA), and Titus K. Mathew (CUSAT). Students and faculties from various institutions across India participated in this three-day residential workshop, which was organized by ICARD – CUSAT, and was coordinated by Aseem Paranjape (IUCAA), Titus K. Mathew, and Charles Jose (CUSAT).

## Short-Term Course on Gravitation and Cosmology

A Short-Term Course on Gravitation and Cosmology was organized at the Department of Physics, Providence Women's College, Kozhikode, by the Teaching Learning Centre (TLC) of IUCAA for the benefit of teachers from their neighbouring colleges and universities, during November 25 – 30, 2019. The main aim of the course was to provide training in teaching Astrophysics, Gravitation and Cosmology as optional papers in the post-graduate curriculum, and updating those who were familiar with the subject with recent developments in the field. The course received an overwhelming response from faculty members of various colleges and universities in Kerala. The total number of participants was limited to twenty-five, with preference being given to the teachers belonging to colleges having post-graduate course in Physics. The course began with an inaugural session, followed by a public lecture titled, "The Physical Basis of General Relativity and its Implications" by Bala Iyer (ICTS, Bengaluru), who later covered the basics of General Relativity, while Titus K. Mathew, and Charles Jose (both from CUSAT, Kochi) explained the fundamentals of Cosmology. Other resource persons included: Sharvari Nadkarni (IIT, Kanpur), and Rishi Khatri (TIFR, Mumbai) on Dark Matter and CMB Radiation, Sanil Unnikrishnan (St. Stephen's College, New Delhi) on Dark Matter, Arunima Banerjee (IISER, Tirupati) on Galaxy Formation and Evolution, Swagat Mishra (IUCAA) on Primordial Black Holes, and Anand Narayanan (IIST, Thiruvananthapuram) on Exoplanets. Athul (CUSAT) organized a training session on Python programming, and also discussed small projects that could be done as part of the MSc curriculum, while Manojendu Choudhury (TLC, IUCAA) discussed the activities of the TLC and teaching methods in Astronomy. The short-term course was coordinated by Jeena Karunakaran (Providence Women's College), and Surhud More (IUCAA).

## Radio Astronomy Winter School

The twelfth edition of the Radio Astronomy Winter School (RAWS) was conducted by the TLC of IUCAA along with the National Centre for Radio Astrophysics (NCRA), Pune, during December 16 – 24, 2019. This school was attended by a total 36 participants, consisting of both faculty members and students from different colleges/universities across the country. The emphasis of RAWS was on hands-on experiments in radio astronomy supplemented by lectures on related topics, including signal processing and error analysis. The lectures were delivered by Joydeep Bagchi, Gulab Dewangan, Ranjeev Misra, D. J. Saikia, and R. Srianand (all from IUCAA), Poonam Chandra, Jayaram N. Chengalur, Bhal Chandra Joshi, Nissim Kanekar, Divya Oberoi, and Subhashis Roy (all from NCRA), and Avinash Deshpande (RRI, Bengaluru), who also demonstrated table-top radio astronomy experiments along with Jameer Manur, and Ashish Mhaske (both from IUCAA).

There were three experiments done by the participants in groups, which were: (i) Observations of the Sun at Radio Wavelengths, (ii) Experiment on Understanding Noise Fundamentals (Johnson Noise), and (iii) Detection of Neutral Atomic Hydrogen (HI) from our Galaxy. These hands on experiments were done with great enthusiasm by all the participants, and were overseen by Prakash Arumugasamy (IUCAA), JoydeepBagchi, Jameer Manur, Ashish Mhaske, Bhal Chandra Joshi, Ruta Kale (NCRA),Subhashis Roy (NCRA), and Avinash Deshpande, and all were also the principal persons organizing the school along with Manojendu Choudhury, and D. J. Saikia.

The visit to the Giant Metrewave Radio Telescope (GMRT) was an exciting event for the participants as they had a close look at the control room, all the subsystems and one of the antennas of one of the most powerful and state-of-the-art radio telescopes in the world operating at low radio frequencies. RAWS ended with presentations by the participants, and a quiz based on what they had learnt during the school.

## Workshop on Statistical Applications in Astronomy and Astrophysics

The Workshop on Statistical Applications in Astronomy and Astrophysics, funded by IUCAA, and with academic support from the IUCAA Centre for Astronomy Research and Development, at the University of Calcutta, Kolkata, was conducted at the Department of Statistics, Assam University, Silchar, during November 20 - 22, 2019. The need of having such a workshop, highlighting the applications of statistics with supporting software for computation was perceived by Asoke K. Sen (Dean, School of Physical Sciences, Assam University).

The workshop was attended by 24 teachers, and research scholars, from the Departments of Statistics and Physics of different colleges and universities of Assam, Meghalaya, and West Bengal. The opening lecture of the workshop was delivered by Dilip C. Nath (Vice-Chancellor, Assam University), who himself has been a well-known statistician in Large Sample Tests. Other speakers were: Sanjeev Dhurandhar (IUCAA), on Statistical detection of gravitational wave signals, Aditya Chattopadhyay (University of Calcutta), on Exploratory data analysis, Gaurangadeb Chattopadhyay (University of Calcutta), on Regression analysis, and Tanuka Chattopadhyay (University of Calcutta), on Astrophysics. The local resource persons:

Atri Deshamukhya, Himadri Sekhar Das, Rama Shanker, and Dibyojyoti Bhattacharjee also delivered talks, and conducted software hands-on sessions on topics relevant to the theme of the workshop. During the valedictory session, the participants expressed their satisfaction on the deliberations, and wished that they should have been provided with more hands-on training. The coordinators of the workshop were Asis Chattopadhyay (University of Calcutta), and Dibyojyoti Bhattacharjee.


## National Workshop on AstroSatData Analysis

The National Workshop on AstroSat Data Analysis was organized by the Department of Electronics, Goa University, in association with IUCAA, during November 20 – 22, 2019 at the Goa University. There were 40 participants. After the inauguration, Ranjeev Misra (IUCAA) gave a brief introduction about the workshop. Words of encouragement by Varun Sahni (Vice-Chancellor, Goa University), and Phil Charles (University of Southampton, UK) served as the perfect start to the workshop.

On the first day, in the first session, Charles delivered a talk on X-ray sources in our Universe. Being part of the construction of major telescopes like SALT, SKA and LSST, he shared deep insights that went during the planning phase of building such institutions. In the second session, Misragave an introduction to time-varying blackholes. He started with fundamental questions on the existence of blackholes, and systematically went on to infer their existence based on specific observations of objects and events that have happened in our Universe. Post lunch, there were hands-on sessions, which were guided by Jayashree Roy, Shah Allam, Yash Bhargava, and Suman Bala (all from IUCAA). These sessions were on introduction to Linux, configuring all the systems, and the astronomical file formats.

The second day started with the enthusiastic talk by Charles, in which the participants learnt simple but powerful techniques to determine masses of objects in our Universe, before getting a deeper understanding of binaries, and deriving some relations for time period and orbital separation. This was followed by a talk by Misra, in which he highlighted the challenges of doing science by giving examples of Hitomi of Japan, and AstroSat of India. All these have been achieved, and have happened after failures and lot of perseverance. In the hands-on sessions, the participants were given lessons on the commands to use the Heasoft Software, developed by NASA, and LAXPC Software of AstroSat, to work with the data of the LAXPC instruments on board the AstroSat.

The concluding day started once again with Charles' lecture, in which he delved more on mathematical techniques to determine the mass of black holes, X-ray binaries and neutron stars. He also explained to distinguish between high-mass and low-mass X-ray binaries as well as accreting X-ray binaries. The data of the Soft X-ray Telescope (SXT) on board the AstroSat, was extracted using the SXT Software, and proceeded to use Xselect Toolbox and DS9 Imaging Software to generate plots and images respectively of Crab Nebula as an example. After lunch, Vithal Tilvi (Directorate of Higher Education, Government of Goa, and Arizona State University, USA) shared unique science features of major telescopes of the world like the Keck and Gemini,

and spoke about his discovery of the farthest galaxy and the possibility of a black hole in it. He went on to show the major upcoming telescopes and his collaboration with some of them and the opportunities therein. Finally, Charles delivered the concluding lecture on the LSST project, in which he was involved. The fundamental physics as well as applied space sciences like asteroid and planetary studies that could be done with the LSST were highlighted.

Erwin Desa (formerly from the Department of Physics, Goa University) was the chief guest for the valedictory function, in which he inspired the participants with his experience. Reshma Raut Desai (Department of Physics, Goa University) proposed the vote of thanks. It was a workshop thoroughly enjoyed by all the participants and would have significant impact on their career paths. The coordinators of the workshop were Rajendra Gad (Department of Electronics, Goa University), Reshma Raut Desai, Ranjeev Misra, and Jayashree Roy.

## Introductory Workshop on Physical Perspectives of Astronomy

The Department of Physics, ICFAI University, Agartala Tripura, jointly with the Department of Physics, Tripura University, Suryamaninagar, organized the Introductory Workshop on Physical Perspectives of Astronomy, during October 30 - 31, 2019. The workshop was organized to foster the interest in Astronomy and Astrophysics among the budding students of BSc and MSc of Tripura, and Northeast India in general.

The resource persons and their topics were: Himadri Sekhar Das (Assam University, Silchar) on (i) Solar system and its small bodies, and (ii) Stellar structure and evolution; Ratan Das (Tripura University) on Celestial coordinates; Santabrata Das (IIT, Guwahati) on Basics of accretion flow around compact objects; Ranjeev Misra (IUCAA) on (i) Black holes in the universe, and (ii) AstroSat: The new era in timing studies; Ayesha Maryam Mazarbhuiya (Assam University, Silchar) on (i) Astronomical data analysis, and (ii) Astronomical image processing using IRAF; Ankur Nath (ICFAI University) on AstroSatdata analysis; Biswajit Paul (NIT, Agartala) on Models of the expanding universe; and Biplob Sarkar (ICFAI University) on The role of magnetic fields in astrophysical processes.

There were 51 participants comprising of under-graduate, post-graduate, and PhD students, along with university/college/school teachers. Out of these, 41 participants were from various colleges and universities in Tripura and 10 were from all across India. A special lecture on Contribution of Michel Mayor and Didier Queloz to discovery of exoplanets was delivered by Santabrata Das, which provided the students an opportunity to get to know about the contribution made by 2019 Nobel Prize laureates Michel Mayor and Didier Queloz towards starting a revolution in astronomy by exploring our home galaxy, the Milky Way, looking for exoplanets.

This workshop was a grand success, and there were a lot of interactions and discussions with the resource persons and the participants. Biplob Sarkar, and Gulab Chand Dewangan (IUCAA) were the coordinators of the workshop.

# International Workshop on LIGO-India

The School of Physical Sciences, Swami Ramanand Teerth Marathwada University (SRTMU), Nanded, Maharashtra, conducted the International Workshop on LIGO-India (IWLI-2019), during December 15-16, 2019, and was jointly organized by IUCAA; Indian Space Research Organization (ISRO), Bengaluru; and SRTMU. Main objective was to begin engaging the scientists, engineers, and technicians, especially, college and university students around the LIGO-India site in instrumentation and science part of the project. As the proposed site of the LIGO-India falls within its jurisdiction, SRTMU (~ 60 km North) naturally attracted more attention, and has been expected to play a lead role in generating interest among the young talents from the nearby region. This workshop was intended mainly for young research scholars, post-doctoral fellows and young faculty members from universities, science and engineering colleges.

More than 200 participants from IITs, NITs, IISERs, Engineering Colleges and Universities attended this workshop, which was inaugurated by the former education minister, Hon'ble Kamal Kishor Kadam. Udhav Bhosle (Vice-Chancellor, SRTMU) was the Chairman for the inaugural programme, while Sukanta Bose (IUCAA), Ajit Kembhavi (IUCAA), Frederick Raab (LIGO Hanford Observatory, USA), and Brian O'Reilly (LIGO Livingston Observatory, USA), were the Guests of Honour. J. S.Bisen (Pro Vice-Chancellor, SRTMU) was also present. The workshop started with a welcome address by M. K. Patil (Director, School of Physical Sciences), who briefly explained the theme and the activities to be carried out during the workshop.

The resource persons were: Varun Bhalerao (IIT – Bombay, Mumbai), Sukanta Bose, Suresh Doravarai (IUCAA), Ajit Kembhavi, Shivaraj Kandhasamy (IUCAA), Sanjit Mitra (IUCAA), Nikhil Mukund (Max-Plank Institute, Germany), Jayant Narlikar (IUCAA), Frederick Raab, Brian O'Reilly, and Gautam Venugopal (Caltech, USA).

The topics covered in the workshop were: Introduction to gravitational waves (GW): Sources and data analysis, GW interferometers, EM follow-up, Building and operating a GW detector, and LIGO – India. In addition to these formal talks, two special interaction sessions were also arranged, in which attempts were made to map the areas of interest of the participants in tune with the upcoming LIGO-India. These sessions were led by Udhav Bhosle, Ajit Kembhavi, Frederick Raab,L. M. Waghmare, and others. All the faculty members, administrative staff and students of the School of Physical Sciences, SRTMU, have taken much efforts in organizing this workshop. Sukanta Bose, and M. K. Patil were the coordinators of the workshop.

As a part of the workshop, a public Marathi lecture by Jayant Narlikar, was held on the topic: Gurutvakarshanachya Lahri (Gravitational Waves), on Sunday, December 15, 2019. The public lecture was intended for school, college students, and the science loving general public at large, from Nanded city with a central theme to educate them on the importance of the gravitational waves and implications of the upcoming cutting-edge technology based mega project LIGO-India in the vicinity of this university. The public lecture was attended by more than 5,000 people, and was an unique event in the history of the university. The good attendance was due to a well coordinated advertisement through posters, banners, Aakashwani, and social media. Also, another public lecture by Fredrick Raab on Challenges in building GW detectors was arranged at MGM's College of Engineering, Nanded.

## National Seminar on Applications of Statistics in Natural Sciences

The National Seminar on Applications of Statistics in Natural Sciences was held at St. Xavier's College, Kolkata, and was jointly organized by the Departments of Statistics and Physics, University of Calcutta, Kolkata, in collaboration with the IUCAA Centre for Astronomy Research and Development (ICARD), Kolkata, during December 16 - 17, 2019. Asis K. Chattopadhyay (Pro-Vice-Chancellor for Academic Affairs, University of Calcutta) was the Chief Guest. Oral and poster presentations showcasing the research of college and university teachers and research scholars from different fields of Natural Sciences were carried on both the days. There were 15 oral presentations and 12 posters. The best oral presentation awards were achieved by Debashish Chatterjee (ISI, Kolkata), Somsubhra Ghosh (IACS, Kolkata), and Sreetama Das Choudhary, and the best poster award was won by Avinanda Chakraborty (Presidency University, Kolkata). In addition, there were specialized lectures by invited eminent speakers: Ayanendranath Basu, Saurabh Ghosh, and Supratik Pal (all from ISI), and Rajesh Kumble Nayak (IISER, Kolkata). More than 100 teachers and research scholars from St. Xavier's College, Kolkata and colleges/universities from other states attended the seminar. Durba Bhattacharya (St. Xavier's College) was the coordinator.


## Workshop on Concepts in Astrophysics

The Department of Physics, Mar Thoma College, Chungathara, Nilambur, Kerala, in collaboration with IUCAA, organized the Workshop on Concepts in Astrophysics, during November 26 - 27, 2019. The main focus was to introduce different areas of Astronomy and Astrophysics to the relatively unexposed participants, and build an interest in the subject. There were forty graduate and post-graduate student participants from

different parts of Kerala and Tamil Nadu. The resource persons were: Ajit K. Kembhavi, A. N. Ramaprakash (both from IUCAA), P. P. Divakaran (formerly from TIFR, Mumbai), Ninan Sajeeth Philip (AIRIS, Kerala), Anand Narayanan (IIST, Thiruvananthapuram), C. D. Ravikumar (University of Calicut, Kozhikode), Biju K. G. (WMO Arts and Science College, Wayanad), Charles Jose (CUSAT, Kochi), Nijo Varghese (S.H. College, Chalakudy), and Tharanath R. (Aquinas College, Kochi). An introduction to astronomy and its jargon were given by Ninan Sajeeth Philip. Then Ajit Kembhavi introduced blackholes and the concepts of gravitational waves. Anand Narayanan talked on exoplanets and their detection methods. The participants got an opportunity to find the radial velocity of an exoplanet during the session. Astronomical techniques, interstellar medium and upcoming optical observatories were introduced by A. N. Ramaprakash. The other resource persons led the participants to explore the sky through a sky-watching programme on the first day of the workshop. As an outreach programme, a parallel session was organized on the first day afternoon for school students to interact with eminent scientists. This session was led by A. N. Ramaprakash, and 76 students from 6 different schools nearby Chungathara actively participated in the programme. The workshop was coordinated by A. N. Ramaprakash and Sheelu Abraham (Mar Thoma College, Chungathara).

## Workshop on Science of the Star in our Backyard: Introduction and Data Analysis


Utilising the Annular Solar Eclipse 2019 as an excellent occasion to popularise Astronomy among the public and to educate science students about the Sun, IUCAA in collaboration with St. Mary's College, Sulthan Bathery, Kerala, has organised an eclipse viewing followed by the Workshop on Science of the Star in our Backyard: Introduction and Data Analysis, during December 26-29, 2019. The applications for the selection of forty participants for the workshop was over subscribed around four times.

The programme started with viewing of the Annular Solar Eclipse on December 26, under the guidance of Samir Dhurde and Sonal Thorve (both from IUCAA). The initial view of the Sun was shadowed, and was missed by the participants. There were five hundred plus public assembled in the ground, and they were very happy to view the later part of the eclipse. The unproductive time was effectively used to answer the questions from the public on Solar Eclipse. A session chaired by Samir Dhurde, organised just after the eclipse, witnessed long and fruitful discussions on various scientific aspects of Solar Eclipse. It also served as an ice-breaking exercise for the participants.

The workshop was inaugurated by Durgesh Tripathi (IUCAA) in the afternoon, chaired by Santhi George (Principal, St. Mary's College). John Mathai Nooranal (Bursar, St. Mary's College) felicitated Dibyendu Nandi (IISER, Kolkata), and Joe Jacob (Newman College, Thodupuzha). The resource persons were: Durgesh Tripathi, Dibyendu Nandi, Aveek Sarkar (PRL, Ahmedabad), Ram Ajor Maurya (NIT, Calicut, Kozhikode), and Nishant Kumar Singh (IUCAA). The various topics of Solar Astrophysics, such as Introduction to Solar Physics and Solar System, Basics of MHD, Star-Planet Interaction, Helio-Seismology, Applications of MHD and Solar Dynamo, Radiative Transfer, LTE and non-LTE, Solar Wind, Facilities in Solar

Astronomy, etc. were discussed. The hands-on sessions for the analysis of solar data, conducted in the afternoons, were guided by Sreejith Padhinjatteri, Abhishek Rajhans, and Vishal Upendran (all from IUCAA).

The many questions which the participants asked, and the long discussions which ensued after each session were the highlights of the workshop. The feedback from the students indicated that they were highly appreciative of the systematically structured lecture sessions, the interesting and educative hands-on sessions, and also of the excellent arrangements for the workshop including the different ethnic food varieties during the workshop. The participants visited Wayanad on the last day afternoon with nostalgic memories of the evergreen forests and the exotic views of the place, and with an enhanced knowledge of the Sun, 'the star in our backyard'.

The programme was coordinated by Durgesh Tripathi, and Joe Jacob. The local organising committee constituted for the workshop was headed by Sreejith C.S., with Shibina. T., Jayesh George, Fibin Varghese, Sunil John, Joby N.G., Pramod K.S., and Biju K.G. as the members.


## Indian Association of Physics Teachers - Under-Graduate Camp in Physics and Astronomy

BITS-Pilani, K.K. Birla Goa Campus organized a Winter Camp in Physics and Astronomy, during December 19 – 22, 2019. The Indian Association of Physics Teachers – Under-Graduate Camp in Physics (IAPT – UGCP), was jointly funded by IUCAA;IAPT, Kanpur; IAPT – Goa Regional Council (GRC); and BITS – Pilani, Goa Campus. It was primarily targeted towards under-graduate students pursuing their final year BSc in Physics. Students from among the top 40 in the national level merit list of NGP Examinees of January 2019, and students in the top 3rd or 4th rank from seven colleges in Goa were selected to attend this camp. Forty-two students attended the camp, of which 16 were from all over India and 26 were from the Colleges in Goa. In addition, there were PhD students, and a couple of faculty members from Carmel College, Goa also attended the camp partially.

The inaugural function was graced by Ramesh Pai (formerly from the Department of Physics, Goa University) as the Chief Guest. As he is the President of the IAPT – GRC, he spoke about the various activities in Goa. Kandaswamy Subramanian, Dipankar Bhattacharya (both from IUCAA), and Arun V. Kulkarni (Department of Physics, BITS -Pilani, Goa Campus) also spoke. They laid out in detail the aims and objectives of the camp, which was to bring meritorious students in contact with active Physics and Astronomy researchers, teachers from Institutions of Eminence, and also to get the participants excited enough to choosing careers in Physics and Astronomy. K.S. Kannan (BITS – Pilani, Goa Campus delivered the vote of thanks.

The resource persons covered wide variety of topics in their lectures, not necessarily found in a typical BSc curriculum. Topics covered by the IUCAA resource persons included, Introductory Astronomy (4 lectures) by Dipankar Bhattacharya, Fluid Dynamics and Magnetohydrodynamics in Astrophysics (3 lectures) by Kandaswamy Subramanian, and Relativity Theory and the Twin Paradox (3 lectures) by Aseem Paranjape. Topics covered by BITS faculty members included, Theory of Lasers (2 lectures) by Prasad Naik, Quantum Measurement Theory (2 lectures) by Radhika Vathsan, Method of Images in Electrostatics and Magneto-statics (2 lectures) by Arun V. Kulkarni, and Atomic and Optical Physics (1 lectures) by Raghunath Ratabole. In addition, there were lectures by the faculty members of the Department of Physics, BITS – Pilani, Goa Campus. Raghurama G. (Director, BITS - Pilani, Goa Campus), who happens to be a physicist, also addressed the participants briefly and offered useful career advice to the students.

The valedictory function was held in the afternoon session of the concluding day, in which Vijay Singh (President of Central IAPT, and formerly from IIT-Kanpur, and former National Coordinator of Physics Olympiad at HBCSE) was the Chief Guest. He along with the other resource persons addressed the students, and awarded them participation certificates. Malati Dessai (Department of Physics, Chowgule College, Margao, Goa) delivered the vote of thanks.

Based on students' response, the camp was a grand success. In the verbal and written feedback, many students expressed their interest in attending more such camps and demanded that the workshops be of longer durations. The coordinators conveyed thanks to B.P. Tyagi, who provided encouragement and the NGPE student list. Special thanks were to Somak Raychaudhury (Director, IUCAA), who supported the idea of using NGPE merit list as a means to identify meritorious under-graduate students from all over India. The coordinators were Dipankar Bhattacharya, and Arun V. Kulkarni.

## Colloquia

- 17.10.2019 Madhavan Varadarajan, on *Loop quantum gravity.*
- 05.11.2019 Hermann Nicolai, on *Symmetry and unification - Can physics be reduced to a single formula?*
- 26.12.2019 Shabnam Iyyani, on *Gamma ray burst: A cosmic mystery.*

## Seminars

- 01.10.2019 Anusha Bhasari, on *Non-equilibrium energy transfer in the solar chromosphere.*
- 30.10.2019 Souradeep Bhattacharya, on *The survey of planetary nebulae in Andromeda (M31): Discrete tracers in the disc and inner halo.*
- 06.11.2019 Sujay Mate, on *Pinning down the cosmic explosions with the SVOM mission.*
- 20.11.2019 Jean Surdej, on *The optical gravitational lens experiment and discovery of multiply imaged quasars with Gaia*
- 21.11.2019 Ruta Kale, on *Megaparsec-scale phenomena in galaxy clusters: A metre-wavelength view.*
- 28.11.2019 Rahul Kumar, on *Ultra-low noise mirror suspension system for gravitational waves detection.*
- 11.12.2019 Anshu Gupta, on *Tackling galaxy formation and evolution using simulations and observations.*
- 17.12.2019 Aditi Vijayan, on *Understanding galaxy evolution through multiphase outflows.*

## Events at IUCAA

### PuLastya Science Festival 2019


To commemorate the birth centenary of Late Shri Pu. La. Deshpande, November 8, 2019,PuLastya Science Festival was organised during November 7 – 9, 2019. The day-time sessions for school students including demonstrations with liquid nitrogen, a session on how to observe the solar eclipse, and interaction with IUCAA PhD students. These were followed by public sky-watching sessions. There was a special session on socially conscious and science minded attitude of Pu. La. and Sunitabai Deshpande. Luminaries who are working on different social and science issues since decades were invited to share their memories of Deshpande couple. These were: Sarvottam Thakur (Sandipani Gurukul, Ratnagiri), Vilas Chaphekar (Vanchit Vikas Kendra, Pune), Mukta Puntambekar (Muktangan Rehabilitation Centre, Pune), Satish Jakatdar (Aashay Film Club, Pune), Virendra Chitrav (Vasundhara Club, Pune), Jayant Sawarkar (Marathi Theatre and Film Industry), and Bharati Bakshi (Muktangan Exploratory, Bharatiya Vidya Bhavan, Pune). Around 1,500 people visited IUCAA on this occasion.

### Teachers' Training

Around 40 teachers from rural schools participated in a training programme at IUCAA, conducted on November 13, 2019, in collaboration with Vande Educational and Research Foundation, Ichalkaranji, Maharashtra. The workshop was focused on basic astronomy, and upcoming solar eclipse. There were hands-on activities and role play sessions, followed by sky-watching activity. The workshop was coordinated by Sonal Thorve (IUCAA).

## Teachers' Training for Observing Solar Eclipse

Grabbing the opportunity of the Annular Solar Eclipse on December 26, 2019, IUCAA SciPOP personnel arranged a special session on December 15, 2019, for teachers on how to observe the eclipse. Samir Dhurde (IUCAA) delivered a talk on the same topic. This was followed by a hands-on session by Geeta Mahashabde (Navnirmiti Learning Foundation, Pune).

## Solar Eclipse

The Annular Solar Eclipse observation and its live streaming was viewed throughout the country on December 26, 2019. At IUCAA, there was an overwhelming response from general public during the interactive sessions conducted by Surhud More (IUCAA) and team. Due to the cloudy sky, they were shown live streaming of the eclipse from different parts of the world. The general public enjoyed the programme even when they could not get an actual glimpse of the eclipse.

# Events outside IUCAA

## Workshop on Basic Astronomy

The students and teachers of the Renaissance School, Mansa, Punjab, participated in a two-day Workshop on Basic Astronomy, conducted by IUCAA SciPO Ppersonnel at Mansa, during October 17-18, 2019. It was the first such a workshop conducted in this place. The workshop comprised of interactive sessions, space toys demonstration, hands-on activities based on observational astronomy and space sciences. Thirty-two students and ten teachers participated in the workshop. They were delighted to observe the Moon using a large telescope.

## India International Science Festival

IUCAA participated in the India International Science Festival (IISF), held at the Biswa Bangla Convention Centre, Kolkata, during November 4 – 8, 2019. As a part of the IISF - 2019, public sky-watching sessions were organised. Tushar Purohit and Jameer Manur (both from IUCAA) were the resource persons. Around 4,000 people participated in the activity.On November 7, a talk on Setting-up Low Cost Science Laboratories was delivered by Shivani Pethe (IUCAA), with emphasis on the importance of such laboratories in each school, even for class 1 students. A guideline for all teachers to setup such labs in their schools was also provided. Around 450 teachers attended the talk.


## INYAS Science Camp

Indian National Young Academy of Sciences, in collaboration with IUCAA and D. Y. Patil Education Society, Kolhapur, Maharashtra, organised the INYAS Science Camp for school students during November 22 – 23, 2019, at Kolhapur. Science toys demonstration, hands-on science, and hands-on astronomy were covered in the sessions. Sonal Thorve, Shivani Pethe, and Rupesh Labade (IUCAA) were the resource persons. Around 180 school students participated in the camp. Sonal Thorve coordinated the camp.

## Jigyasa Science Exhibition

A science exhibition open for all was organised at IISER, Pune, during December 19 – 20, 2019, by the Agastya International Foundation in collaboration with IISER, Pune and IUCAA SciPOP. Rupesh Labade was the resource person, who coordinated the telescope making activity. There were 200 student participants, and round 2,000 people visited the exhibition.

## Annular Solar Eclipse Viewing at Different Parts of India

On the occasion of the Annular Solar Eclipse, a camp was jointly organised during December 25 – 26, 2019,at Coimbatore, Tamil Nadu, by the Vigyan Prasarof the Government of India and JyotirvidyaParisansth, Pune. Tushar Purohit was the resource person. There were lectures, and hands on activities during the camp. The participants were 180 teachers from different parts of India. Rupesh Labade and Maharudra Mate volunteered in the camp.

As a part of the IUCAA Workshop on Science of the Star in our Backyard, held at St. Mary's College, Sulthan Bathery, Kerala, IUCAA SciPOP organised the Annular Solar Eclipse viewing for the general public on December 26, 2019.Samir Dhurde and Sonal Thorve were the resource persons. The eclipse was viewed using

safe solar eclipse goggles. Despite the cloudy sky and unfavourable weather conditions, around 400 people had fun patiently getting the glimpses of the eclipsed sun in the different phases between the windows of clouds. Observation session was followed by an interactive talk on the eclipses delivered by Samir Dhurde.

Jameer Manur and team observed the Annular Solar Eclipse from Kasaragod, Kerala. The weather permitted the team to observe and capture annularity of the eclipse.

## World Record Event, Kolkata

IUCAA SciPOP team was a part of the World Record Event for the "Largest Astrophysics Lesson", during the India International Science Festival 2019, held at the Science City, Kolkata.

The lecture on "Spectra: From our daily lives to astrophysics" was delivered by Samir Dhurde (IUCAA). Officially, 1,598 school students qualified for the world record although the total attendees were beyond 2,000. At the end of this lesson about spectroscopy, they were helped in making a handy paper spectroscope with which they could investigate light sources by themselves.

## TMT – India Outreach

The IUCAA SciPOP team consisting of Rupesh Labade, Shivom Gupta, and Vaibhav Sawant helped to conduct the TMT – India outreach week (November 26 – 30, 2019) in the Science City, Kolkata. They enacted a special themed play combined with science demonstrations, highlighting the developments in science since the time of Galileo Galilei. Several lectures by TMT project experts were also conducted, which saw a good response from school and college students.

## Telescope Making Workshops

IUCAA SciPOP in collaboration with Vigyan Prasar conducted two Telescope Making Workshops at Navodaya Vidyalayas, Kamrup, Assam, during October 30 - November 4, 2019, and at Kendriya Vidyalaya, Gomtinagar, Lucknow, Uttar Pradesh, during November 18 – 22, 2019. Tushar Purohit was the resource person in these workshops. In each workshop, 20 larger (5 inch) reflecting telescopes were made by teachers and students.

## IAUS 358, Conference on Astronomy for Equity, Diversity and Inclusive

The IAUS 358, Conference on Astronomy for Equity, Diversity and Inclusive was held at the National Astronomical Observatory of Japan, Mitaka, during November 12 – 15, 2019.

The conference consisted of intensive panel discussions and presentations regarding the climate of inclusion in astronomy, the advantages and efforts taken by astronomers globally to make astronomy diverse and inclusive.

The talks by experts included topics: Using cultural astronomy to create a more inclusive astronomy, and the need for reinforcing the implementation of inclusion and diversity strategies as ordinary act deeper, wider, faster programme: A platform for collaborative science inclusion. Neha Deshpande (IUCAA) presented the efforts IUCAA SciPOP is taking in making astronomy inclusive. She was invited to chair a discussion session about the astronomy for equity.

Along with a lot of statistics and efforts to bring about a positive change in society by experts, Deshpande concurred that an open dialogue and acknowledgement of the diversity in abilities of people is perhaps the key to the climate of inclusivity.


## Rural Outreach Events

### Science Toys Demonstration

For the students of classes 6 to 10, a Science Toys Demonstration was conducted at TBM Finishing School LLP at Otur, Maharashtra, on October 26, 2019, by Rupesh Labade. Around 80 students enjoyed the demonstration.

### Science Exhibition

A Science Exhibition for Ambegaon Taluka schools was organised at Girawali, Maharashtra, by the Zilla Parishad, during December 3 – 4, 2019.

Fifty schools nearby IUCAA Girawali Observatory participated in the exhibition. IUCAA SciPOP was invited to present science toys and the telescope demonstrations.

Rupesh Labade was the resource person. Around 1,900 students visited and enjoyed the exhibition.

### State Level Children's Science Congress

IUCAA SciPOP was invited to the 27th State Level Children's Science Congress held during December 6 – 7, 2019, at Samarth Institute, Belhe, Maharashtra. Rupesh Labade coordinated the event. About 3,000 students participated and enjoyed learning science with toys.

It was followed by sky-watching in the evening. Around 350 people visited and experienced a delightful view of telescopic objects like the Moon and Saturn. Tushar Purohit and Sonal Thorve were the resource persons.

### Teachers' Training

A two-day training for secondary school teachers from rural area in and around IUCAA Girawali Observatory was held during December 14-15, 2019. On the first day, there were demonstrations of science toys along with hands-on activities related to the topics sound and light.

The session was followed by a visit to IUCAA Girawali Observatory, at which sky-watching session was arranged.

The second day was focused on the Annular Solar Eclipse that was going to be on December 26, and was observable from India. This included hands-on activities and role play sessions. The training was coordinated by Rupesh Labade.

## Other Regular Events

The IUCAA SciPOP group has conducted one science toys workshop, one basic astronomy workshop, one sky-watch session, and seven campus visits with an approximate reach to about 500 people.


### Second Saturday Lecture/ Demonstration Programmes

November 16, 2019: Pratik Dabhade (IUCAA), on *Radio Signals from Space: Unveiling the Mysteries of the Universe*; December 14, 2019: Samir Dhurde (IUCAA), and Geeta Mahashabde (Navnirmiti Learning Foundation, Pune), on *Observing Solar Eclipse on December 26, 2019.*

### Public Talk

October 22, 2019: Gary Melnick (Center for Astrophysics, Harvard - Smithsonian, USA), on *Interstellar Water: Past, Present, and Future*

*All the talks are available at our YouTube Channel - https://www.youtube.com/user/IUCAASciPOP/*

## Obituary

**Jean - Claude Pecker**

Jean-Claude Pecker passed away at the age of 97. For those associated with IUCAA in early days, he will be remembered as a good friend. His interests ranged from Solar Physics to Cosmology and he rightfully called himself a radical so far as his ideas on cosmology were concerned. He had good contacts at College de France, Institut d'Astrophysique and the observatories in Paris, where he spread the word around of the new arrival, IUCAA. He will be sorely missed.

- Jayant Narlikar

## Visitors
## (October- December 2019)

T.S. Aakash, Kinsuk Acharyya, Nafisa Aftab, Aman Agrawal, Sushmita Agarwal, Neha Ahlawat, Gazi Ameen Ahmed, G. Ambika, Rahul Kumar Anand, Juan Angulo, Ayesha Anjum, G. K. Ankush, Anupama, Surbhi Arora, Abdul Aziz, Kalyani Bagri, Naman Bajaj, Agnibha Banerjee, Arunima Banerjee, Rameshwar Bankar, Soummyadip Basak, Sumit Bawari, Kriti Baweja, Tomaso Belloni, Shubham Bhagat, Vinay Bharambe, Anusha Bhasari, Bratati Bhat, Naseer Iqbal Bhat, Souradeep Bhattacharya, Yashpal Bhulla, G.R. Bhuvana, Ludovic Biennier, Aparna Bisht, Ratan Singh Bisht, Mahasweta Biswas, John Booth, Olag Pratim Bordoloi, Anshuman Borgohain, Aditi Borse, Nirban Bose, David Buckley, Mridusmita Buragohain, Jan Cami, Gargee Chakraborty, Koushik Chakraborty, Shubhadip Chakraborty, Swadesh Chand, Mahesh Kumar Chandra, Sanghita Chandra, Suresh Chandra, Philip Charles, Anusheela Chatterjee, Joydeep Chatterjee, Goutami

Chattopadhyay, Surajit Chattopadhyay, Tanmoy Chattopadhyay, Laxmikant Chaware, Gulafsha Begom Choudhury, Kishalay Choudhury, Sourav Roy Chowdhury, Encarni Romero Colmenero, Lisa Crause, Ankan Das, Himadri Sekhar Das, Pratyush Kumar Das, Abhirup Datta, Cristian Davis, Debabrata Deb, Kabita Deka, Avinash Deshpande, Mrunmayi Deshpande, Sapam Gayatri Devi, Tanuj Kumar Dhar, Saee Dhawalikar, Payaswinee Dhoke, Rahul Dhurkunde, Marcos Diaz, Krishnaveni P. Dinesh, Vaibhav Dixit, Broja Gopal Dutta, Izumi Endo, K.N. Ganesh, Shashikiran Ganesh, Apratim Ganguly, Akash Garg, Suyog Garg, Robin T. Garrod, Vaibhavi Bhalchandra Gawas, Robert Georges, Prabir Gharami, Ankita Ghosh, Rupamanjari Ghosh, Tuhin Ghosh, Ankur Gogoi, Prasanta Gorai, G. K. Goswami, Pranjupriya Goswami, Pranesthan Govender, Milind Gowardhan, Srashti Goyal, Anna Green, Shivappa B. Gudennavar, Atanu Guha, Charu Gupta, Prateek Gupta, Sagar Kumar Gupta, Saurabh Gupta, V. B. Gupta, Arjun Gurkhude, Prithish Halder, Mubashir Hamid, Giles Hammond, K.P. Harikrishnan, Narola Harsh, Priya Hasan, Martin Hendry, IkSiong Heng, Eric Herbst, Jyotishree Hota, Jack Hughes, Nazma Husain, K. Indulekha, Annu Jacob, Joe Jacob, Rinku Jacob, Sangeeta Jain, Sidhant Jakhar, Susmita Jana, Philip Jones, Jessy Jose, Jobin Mathew Jose, Vishal Joshi, Kanti Jotania, Rajeev K., Sathya Narayanan K., Anusree K. G., Md. Mehedi Kalam, Mohan Kale, Rutu Kale, Sachin Kaothekar, Shasvath Kapadia, Shrriya Kapoor, Karan, Shreejaya Karantha, Jaya Shivangani Kashyap, Unnati Kashyap, Krishnaswamy Kasturirangan, Aditi Shiv Shankar Kaushik, Nishikanta Khandai, Sheeraz Ahmad Khanday, Rukaiya Khatoon, Michiko Koike, Aditi Krishak, Ajay Kumar, Anil Kumar, Lokesh Kumar, Nitesh Kumar, Prashant Kumar, Rahul Kumar, Noble Kurian, Adesh Kushwaha, Rahul Kumar Kushwaha, Ioannis Kypriotakis, Namitha L.S., Lizette Labuschagne, C.S. Lajitha, Sean Leavey, Ashish Mahabal, Harsh Maheshwari, Dishari Malakar, Zahoor Ahmad Malik, Gitika Mall, Labani Mallick, Palas Mandal, Soma Mandal, Yashodhan Manerikar, Aaqib Manzoor, Aditi Marathe, Sujay Vivek Mate, Blesson Mathew, Anju Maurya, Ayesha Maryam Mazarbhuiya, Jordan McGinn, Ashish Meena, Gary Melnick, Christopher Messenger, Ashish Mhaske, Joanna Mikolajewska, Shrish Misra, Satoshi Miyazaki, Keoikantse Moses Mogotsi, Soumen Mondal, Bhaswati Mookerjea, Sneha Prakash Mudambi, Arunava Mukherjee, Ameer Mulla, Shivam Munshi, Masum Murshid, Jayant Murthy, C. Muthumariappan, Ankur Nath, Nilam Navale, Hermann Nicolai, Anil Nimkar, Niku Nitin, Alex Nitz, Clifford Nxomani, Cesar Ocampo, Devendra Ojha, Amitesh Omar, Takashi Onaka, Neha P. R., Manjusha P. V., Adittya Pal, Avinash Kumar Paladi, KanikPalodhi, N. Panchapakesan, A.C. Pandey, Kanhaiya Lal Pandey, Ruchi Pandey, S.K. Pandey, Sanjay Pandey, Mahadev Pandge, Ankita Patel, Amit Pathak, Lalit Pathak, Deepak Patil, M. K. Patil, Abhinav Patra, Sudeshna Patra, B.C. Paul, Nupur Paul, Surajit Paul, Devraj Pawar, SrinidhiPawar, Els Peeters, Ninan Sajeeth Philip, Gabriele Ponti, Anirudh Pradhan, Ram Prasad Prajapati, Suman Pramanick, Prabhunath Prasad, K. Praveen Kumar, Raj Prince, Akshay Priyadarshi, Marina Prokopyeva, Prajesh Purohit, Abinaya Swaruba R., Frederick J. Raab, Paul Rabe, Anisur Rahaman, Farook Rahaman, Nilofar Rahman, Archita Rai, Harsha Raichur, MainpalRajan, Chayan Ranjit, Sujata Kundu Ranjit, A.R. Rao, Shantanu Rastogi, B.S. Ratanpal, Pooja Singh Rathore, Divya Rawat, Katherine Rawlins, Saibal Ray, Shankar Ray, Dinesh Reddy, Arijit Roy, Arun Roy, Kinjal Roy, Prabir Rudra, Sunil Kumar S., Margarita Safonova, Gokul Saha, Prerna Saharan, Sanjay Kumar Sahay, Abinash Sahoo, Gautam Saikia, Dinesh Saini, Itsuki Sakon, Joy Sanghavi, Marek Sarna, Saurabh, Kshitij Sawant, Bonanza Sebastian, Asoke Kumar Sen, Vishant Shah, Md. Arif Shaikh, Michael Shara, Devanshu Sharma, Lakhi Sharma, Ranjan Sharma, Gargi Shaw, Amit Shukla, Estuti Shukla, Anvar Shukurov, Milan Sil, Apurva Singh, Gyan Prakash Singh, H. P. Singh, Karanpreet Singh, Manju Singh, S. K. Singh, Surendra Vikram Singh, Akriti Sinha, Bhalamurugan Sivaraman, Rosalind Skelton, Ulysses Sofia, Meghna Soni, Kate R. Soule, Kishore Sourav, L. R. Sreedhanya, H. Sree Kanth, P. Sreekumar, Satyam Srivastav, Mudit Srivastava, Vandna Srivastava, Alexei Starobinsky, Akshaya Subbanna, Harley Suchiang, Jean Surdej, Subhashree Swain, Rajalakshmi T. R., Arun Thampan, Jessymol Thomas, Lijo Thomas, Neal Thomas, Harshit Tiwari, Linda Tobin, Alexei Toporensky, Apara Tripathi, Arman Tursunov, Eduardo Unda-Sanzana, C. S. Unnikrishnan, Anisul Ain Usmani, Ramshad V. R., Vatsalya Vaibhav, Petri Sami Mikael Vaisanen, Vanzarmawii, Madhavan Varadarajan, Gunjan Varshney,Varun, Ram Vashisht, Akant Vats, Punyakoti Ganeshaiah Veena, K. R. Venugopal, Gautam Venugopalan, Tejaswi Venumadhav, Chetan Verma, Murli Manohar Verma, Sarita Vig, Aditi Vijayan, K. VijayRaghavan, Manas Vishal, R. G. Vishwakarma, Pavan Vynatheya, Eric Wilcots, J. S. Yadav, and Shivani Yadav.

## Visitors Expected

### January 2020

Rana Adhikari, Caltech, USA; K. Aditya, IISER, Tirupati; Anirban Ain, Instituto Nationale di Fisica Nucleare, Pisa, Italy; Bijan Kumar Bagchi, Shiv Nadar University, Greater Noida; Samuzal Barua, Gauhati University, Guwahati; Ankita Bera, Presidency University, Kolkata; Prasanta Bera, University of Southampton, UK; Arun Kumar Bidhan, Jamia Millia Islamia, New Delhi; Aparna Bisht, AEI, Hannover, Germany; Laura Cadonati, Georgia Institute of Technology, USA; Avinanda Chakraborty, Presidency University, Kolkata; Peter Couvares, Caltech, USA; Prasun Dhang, Tsinghua University, Beijing, China; Payaswinee Dhoke, Dharampeth M. P. Deo Memorial Science College, Nagpur; Saili Dutta, NISER, Bhubaneswar; Bhooshan Gadre, AEI, Potsdam, Germany; Jeethu George, St. Alberts College, Ernakulam; Sushant Ghosh, Jamia Millia Islamia, New Delhi; Umananda Dev Goswami, Dibrugarh University; Sagar Sing Goyary, Rajiv Gandhi University, Rono Hills; Jyotishree Hota, NIT, Rourkela; Annu Jacob, IIA, Bengaluru; Bhuvnesh Jain, University of Pennsylvania, USA; Anusree K. G., Mahatma Gandhi University, Kottayam; Peter Kamphuis, Astronomisches Institut RUHR University, Germany; Shashi Kanbur, SUNY, Oswego, USA; Aafaque Khan, University of Arizona, USA; Subham Kuri, Kohima Science College; Manzoor Malik, University of Kashmir, Srinagar; Helen Mason, University of Cambridge, UK; Rajsekhar Mohapatra, Australian National University, Canberra, Australia; Chayan Mondal, IIA, Bengaluru; Pradip Mukherjee, Barasat Government College; Hamsa Padmanabhan, CITA, Toronto, Canada; S. K. Pandey, Pandit Ravishankar Shukla Unviersity, Raipur; Manu Paranjape, University of Montreal, Canada; Kalyan Radhakrishnan, INAF-Osservatorio Astronomico di Padova, Italy; Swara Ravindranath, Space Telescope and Science Institute, Baltimore, USA; Divya Rawat, IIT, Kanpur; Sonali Sachdeva, The Kavli Institute for Astronomy and Astrophysics, China; Satish Kumar Saravanan, International Institute of Physics, Brazil; Rathin Sharma, Rabindranath Tagore University, Hojai; Vipin Kumar Sharma, University of Lucknow; Gargi Shaw, Centre for Excellence in Basic Sciences, Mumbai; Vikram Soni, Jamia Millia Islamia, New Delhi; Jishnu Suresh, Institute for Cosmic Ray Research, Tokyo, Japan; Subhashree Swain, Pondicherry University; and Rahul Kumar Walia, Jamia Millia Islamia, New Delhi.

### February 2020

Priti Gupta, Kyoto University, Japan; K. Sri Kavya, Andhra University, Visakhapatnam; Ankur Nath, The IFCAI University, Tripura; Hafiz Nazeer, University of Calicut, Kozhikode; K. Niharika, Andhra University, Visakhapatnam; Joe Philip Ninan, The Pennsylvania State University, USA; Zainul Abid P., University of Calicut, Kozhikode; Sayan Patra, Vrije Universiteit Amsterdam, The Netherlands; Amit Seta, Australian National University, Canberra, Australia; Unnikrishnan Suresh, Jagiellonian University in Krakow, Poland; Rajalakshmi T. R., Mahatma Gandhi University, Kerala; and Vinutha Tummala, Andhra University, Visakhapatnam.

### March 2020

Subhra Bhattacharya, Presidency University, Kolkata; Mayukh Pahari, University of Southampton, UK; and Nupur Paul, Jadavpur University, Kolkata.

## Long Term Visitors

Ajesh Gulati, TMT Project Office, USA; David Hildich, University of Lisbon, Portual; Ashish Mahabal, Caltech, USA; Ninan Sajeeth Philip, Artificial Intelligence Research and Intelligence Systems, Kerala; A. R. Rao, Mumbai; and Sravani Vaddi, C/o IUCAA, Pune.

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IUCAA, Post Bag 4, Ganeshkhind, Pune 411 007, India.
Phone : (020) 2569 1414; 2560 4100 Fax : (020) 2560 4699
email : publ@iucaa.in Web page : http://www.iucaa.in/