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## Astronomy Centre for Educators

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The Astronomy Centre for Educators (ACE) has been established recently at IUCAA, with the two main constituent units, at present, being the National Resource Centre (NRC) for developing the Annual Refresher Programme in Teaching (ARPIT) for teachers, and the Teaching Learning Centre (TLC) for further developing astronomy teaching in the country with an emphasis in the higher education sector. Both the programmes are being funded by the Ministry of Human Resource Development (MHRD), Government of India, under the Pandit Madan Mohan Malaviya National Mission on Teachers and Teaching scheme. Professor D.P. Singh, Hon'ble Chairman, UGC laid the foundation stone on January 4, 2019, for the new building funded by the TLC grant.



The construction is making steady progress, and the building is expected to be completed by the end of 2019.

# Workshop on Celestial Mechanics and Dynamical Astronomy



To motivate enthusiastic students to pursue a research career in Celestial Mechanics, Astronomy and Astrophysics, the Department of Mathematics, Central University of Rajasthan (CURAJ), Ajmer, in collaboration with IUCAA, conducted a five day Workshop on Celestial Mechanics and Dynamical Astronomy (CMDA - 2019), during January 7 - 11, 2019. Main objective of the workshop was to provide basics on the principles of Celestial Mechanics and Dynamical Astronomy, and their different aspects, so that it can help researchers to explore their ideas on realistic models of many areas of Astronomy, Astrophysics, Celestial Mechanics, and other branches of science. Moreover, to provide a platform for both established and young budding researchers to interact with each other to discuss about their research problems, which may establish new research collaborations.

Workshop begun with a short inaugural session, which was presided by Arun K. Pujari (Hon'ble Vice Chancellor, CURAJ), and the inaugural function was graced by Ranjan Gupta (IUCAA). There were 21 lectures, 4 interaction sessions,

and 5 hands-on sessions in computer lab, and these were conducted by the invited speakers: Ranjan Gupta, Rashmi Bhardwaj (GGSIU, New Delhi), Manish Dev Shrivastava (CURAJ), S. N. Hasan (MANUU, Hyderabad), Kanak Saha (IUCAA), Amit Chakraborty (CURAJ), M. Xavier James Raj (VSSC-ISRO, Thiruvananthapuram), Anand Kumar (CURAJ), and Ram Kishor (CURAJ), with active engagement of PhD scholars: Soumen Bera, Yousuf Salim, Ravi Kumar Jha, Poonam Meena, Richa Rajora, Ratan Lal, and Sarita Bugalia of the department. The topics covered in the workshop broadly were from the areas of Celestial Mechanics, and Astronomy.

Totally 45 participants were selected from 175 applicants from almost 20 different states of the country. There was a popular lecture and an interaction session, which was open to general public, and these created an awareness among the public about the research work being conducted at the University campus. This was the first such workshop on this subject, hosted by CURAJ. Ram Kishor and Kanak Saha were the coordinators of the workshop.

## Congratulations to . . .

**Sanjeev Dhurandhar**, on being selected for *Meghnad Saha Memorial Gold Medal (2018)* by The Asiatic Society, Kolkata.

**Jayant Narlikar**, on being conferred with the *Mahatma Jyotirao Phule Puraskar* by the Maharashtra Rajya Sahitya Ani Sanskruti Mandal, Mumbai.



## Workshop on Multi-Wavelength Sky Observations: AstroSat and Beyond



The Discipline of Astronomy, Astrophysics and Space Engineering, IIT - Indore, organised a Workshop on Multi-Wavelength Sky Observations: AstroSat and Beyond, during February 3 - 7, 2019, in association with TIFR, Mumbai and AstroSat Science Support Cell at IUCAA. This event was one of the first scientific events conducted as a part of the 10-year anniversary celebrations of IIT - Indore. The programme of the workshop consisted of scientific sessions and hands-on data analysis sessions using data from LAXPC, SXT, CZTI and UVIT instruments on-board AstroSat. H. M. Antia (TIFR, Mumbai), Sudip Bhattacharyya (TIFR, Mumbai), C. S. Stalin

(IIA, Bengaluru), Jayashree Roy (IUCAA), Md. Shah Alam (IUCAA), Sunil Chandra (North-West University, South Africa), Abhirup Datta (IIT - Indore), Bhargav Vaidya (IIT - Indore), Nilima Kamble (TIFR, Mumbai), Kasturi Warang (TIFR, Mumbai), Prajwel Joseph (IIA, Bengaluru), and Ashish Devaraj (IIA, Bengaluru) were the speakers and tutors. There were 25 participants comprising of PhD students, postdocs, and university teachers from all over India. In the scientific sessions, a wide span of topics, including Neutron Stars, Black Holes, Galaxies and Galaxy Clusters, AGNs, Jet Simulations were discussed. A detailed introduction of the instruments and their working techniques was presented. During the hands-on sessions, the participants analyzed X-ray data from the black hole system Cygnus X-1 and the Crab pulsar, to study the spectral and timing properties of the sources. They extracted images from the globular cluster NGC 188 and carried out photometry of the stellar data. At the end of the workshop, a symposium was conducted, where the participants and a few experts presented their recent research on topics relevant to AstroSat science goals. Manoneeta Chakraborty (IIT - Indore), and Ranjeev Misra (IUCAA) were the coordinators of the workshop.

## SITARE: Advanced Workshop on Astrophysics



Southampton IUCAA Training for Astronomical Research and Education (SITARE) is a programme initiated by IUCAA and

the University of Southampton, UK. It is sponsored by Science and Technology Facilities Council (STFC), UK. The objective of





the programme is to motivate talented students to pursue a research career in Astronomy, Astrophysics, and related areas. To introduce students to these areas, four workshops were conducted at Tezpur (Assam), Raipur (Chattisgarh), Thodupuzha (Kerala), and Kathmandu (Nepal).

Selected students from these workshops were invited to participate in the Advanced Workshop on Astrophysics at IUCAA, during January 10 - 16, 2019. There were 30 students

from India and ten from Nepal. They were given lectures in advanced topics by IUCAA faculty, and Phil Charles and Poshak Gandhi from the University of Southampton. The students displayed their interest and fascination towards Astrophysics by presenting posters. Eight students were selected from this workshop, and they visited the University of Southampton, and interacted with their faculty by doing a project. The workshop at IUCAA was coordinated by Ranjeev Misra and Ajit Kembhavi, both from IUCAA.

## Conference on Formation and Evolution of Star Clusters



A Conference on Formation and Evolution of Star Clusters was organised at Maulana Azad National Urdu University

(MANUU), Hyderabad, during January 21 - 24, 2019. The objectives of this conference were to expose young

scientists (students, research scholars and faculty) to modern trends in star clusters by giving lectures by leading experts (National/International) in these areas, and to promote international collaborations, with emphasis on the exchange of ideas, information and opinions. The participants have explored the observational and theoretical study of star clusters, using observations, simulations, and GAIA data, etc. There were hands-on sessions on GAIA DR2 analysis in the afternoon sessions.

There were about 70 participants from various parts of the country from leading institutions and various universities, and one from Grenoble, France. Three talks were given through Skype by speakers from MIT, CfA, USA; and the Niels Bohr Institute, Denmark. More details are available at <https://fesc2019.wordpress.com/>

The inaugural lecture was delivered by Ram Sagar (IIA, Bengaluru). Convenor of the conference was Priya Hasan (Department of Physics, MANUU) and the co-convenor was S. N. Hasan (Dean, School of Sciences, and Head, Department of Mathematics, MANUU). The conference was jointly funded by IUCAA and MANUU. The coordinators of the conference were Priya Hasan, Shantanu Rastogi (DDU Gorakhpur University), and Ranjeev Misra (IUCAA).



## Colloquia

17.01.2019: **Dipanjan Mitra** on *Relativistic charge solitons created due to non-linear Landau damping: A candidate for explaining coherent radio emission in pulsars.*

31.01.2019: **Pierluigi Monaco** on *Precision cosmology with large-scale structure: The challenge of percent accuracy.*

07.02.2019: **Sukanta Bose** on *What next for gravitational waves?*

14.02.2019: **Avinash Khare** on *Different facets of PT – Symmetry.*

07.03.2019: **Angelos Vourlidis** on *Immersed in the solar wind: The new era of solar physics space mission.*

## Seminars

30.01.2019: **Suvodip Mukherjee** on *A few new frontiers in cosmology with supernovae and binary black hole.*

11.02.2019: **Marten van Kerkwijk** on *Plasma lensing of the black widow pulsar.*

06.03.2019: **Philippe Landry** on *New developments in gravitational-wave inference of the neutron star equation of state.*

20.03.2019: **Prabhakar Tiwari** on *Our Universe at redshift  $\sim 1.0$ .*



# National Science Day



The celebrations of National Science Day on February 28, 2019 attracted numerous groups of students along with teachers, parents and general public, who came from around Pune and other parts of Maharashtra. On this National Science Day, around 10,000 people visited IUCAA in the day session, and a whopping 2,000 odd people attended the sky watching at night. This shows the hunger of people to associate better with Science and Scientists.

The main campus of the Centre was adorned by the scale-models of different Astronomy and Astrophysics projects of public interest like, LIGO-India, Thirty Metre Telescope, Aditya L1, and AstroSat. A number of spectacular posters designed and presented enthusiastically by research scholars of IUCAA were displayed, which made the people aware of the on-going research and new developments in the subject. Apart from these, the Foucault pendulum, the statues of great scientists on the campus, short interactive sessions on 100 years of testing General Relativity, demonstrations of Laser

Interferometry and Gravitational Waves, Spectroscopy and Raman Effect, and Radio Astronomy pulled a large number of people.

Short talks on How do we study the Large Scale Structures in the Universe?, Vividh Prakashatun Vishwa Pahtana, The Cosmic Recipe: Constituents of our Universe, Radio Waves and Active Galactic Nuclei in the Universe, and Sitaron ka





Jeevanchakra Hamein Kya Batata Hain? were delivered by Shishir Sankhyayan, Jameer Manur, Swagat Mishra, Konstantinos Kolokythas, and Yash Bhargava respectively, which kept the audience rooted in the Chandrasekhar Auditorium during the morning session. Parallel events like Science Toys demonstrations, coordinated by Shivani Pethe and Rupesh Labade; Space Toys demonstrations, coordinated by Shivom Gupta; and demonstrations on Telescope Making, coordinated by Tushar Purohit were keeping the general public magnetized in the Science Park area throughout the day time.

In the afternoon, there was a live interaction with Jayant Narlikar and Somak Raychaudhury, who eloquently answered several Astronomy related questions from the public. This was coordinated by Surhud More and Anupreeta More. It was a great pleasure to hear the wonderful questions

regarding our Universe that were asked by young school kids. Along with the chock-full auditorium, many viewers enjoyed the live webcasting of the sessions online as well. Following this, there were special talks on Women in Astronomy; Citizen Science: Scientific Discoveries at your Fingertips; It is Time to Woman-up for Science; Being a Part of a Dream Project: Aditya L1 Mission; PhD Ab Tak - Motivation, Challenges and Struggle; Journey with the Stars; Fascinated to the Most Energetic Window to the Universe; and My Journey in Astrophysics, were delivered by Anupreeta More, Manasadevi P. T., Avyarthana Ghosh, Ruchika Seth, Sonal Thorve, Vidushi Sharma, and Pranoti Panchbhai respectively. This session was coordinated by Manasadevi P. T.

A public talk on the 2018 Physics Nobel Prize, titled: LASERs as Optical Traps and Bullets, was delivered by G. V. Pavankumar (IISER, Pune).





As per the tradition, there were events for school students prior to the open day. IUCAA Public Outreach personnel conducted a science quiz, along with essay writing, and drawing competitions for the rural students of the Ambegaon Taluka on February 12, 2019. Shreejit Jadhav, Abhishek Rajhans, and Prakash Tripathi (all from IUCAA) enthusiastically encouraged students from 30 rural schools, who competed at the venue generously provided by the New English School, Landewadi. A lot of help also came from the IUCAA Girawali Observatory staff, Nilesh Pokharkar along with others.

On February 23, 2019, about 350 students from 57 schools in Pune city responded to IUCAA's invitation and participated in another set of inter-school competitions. Students from classes VIII to X took part in the drawing, essay, poetry and science quiz competitions. Prayas Sutar (from Tata Institute of Social Sciences, Mumbai) gave an interactive talk to the teachers, who accompanied the students. After the finals of the quiz competition, all winning students received their prizes from Somak Raychaudhury (Director, IUCAA), which included the students from the rural schools, who were specially invited to IUCAA for a visit that day. All the students were enthused and also very happy to have a chance to interact with the IUCAA scientists during these National Science Day celebrations.

A walkthrough and a time-lapse video of the National Science Day 2019 at IUCAA was beautifully composed by Ishan Shinde with the help of Nilkantha Gholap, Shashank Tarpe, and Atharva Pathak, and the same is available at: <https://youtu.be/1X5Kb93E3I8>.



## Drawing Competitions Winners

CITY SCHOOLS	RURAL SCHOOLS
 <p style="color: red; text-align: center;"><b>1st Prize</b></p> <p style="text-align: center;"><b>Diyashree Karunakar Devadiga</b></p>	 <p style="color: red; text-align: center;"><b>1st Prize</b></p> <p style="text-align: center;"><b>Rinku Abhishek</b></p>
 <p style="color: red; text-align: center;"><b>2nd Prize</b></p> <p style="text-align: center;"><b>Siddhi Sanjay Deokar</b></p>	 <p style="color: red; text-align: center;"><b>2nd Prize</b></p> <p style="text-align: center;"><b>Siddhi Santosh Doke</b></p>
 <p style="color: red; text-align: center;"><b>3rd Prize</b></p> <p style="text-align: center;"><b>Gauri Kerappa Chandanshive</b></p>	 <p style="color: red; text-align: center;"><b>3rd Prize</b></p> <p style="text-align: center;"><b>Sandesh Sonba Khilari</b></p>



# Winners in the National Science Day Competitions

## RURAL SCHOOLS

### Drawing : \_\_\_\_\_

**First Prize:** Rinku Abhishek, Yashwantrao Chavan Madhyamik Vidyalaya, Ambegaon Vasahat.

**Second Prize:** Siddhi Santosh Doke, New English School, Landewadi.

**Third Prize:** Sandesh Sonba Khilari, Pandit Jawaharlal Nehru Vidyalaya, Nurgudsar.

**Honorary Mention:** Tammay Prashant Wabale, Mahatma Gandhi Vidyalaya, Manchar.

### Essay Writing: \_\_\_\_\_

**First Prize:** Siddhesh Vinayak Darekar, Janata Vidyamandir, Marathi Medium, Ghodegaon.

**Second Prize:** Jinesha Dhiraj Samdadiya, Nalanda English Medium School, Manchar.

**Third Prize:** Pranjal Kailas Argade, Kalbhairavnath Vidyalaya, Marathi Medium, Khadki.

### Science Quiz: \_\_\_\_\_

**First Prize:** Ghanshyam Nareshwar Pandey, Gururaj Prashnat Saraph, and Siddhant Suresh Erande, New English Medium School, Ghodegaon.

**Second Prize:** Sonam Imtiyaj Shaikh, Tanmay Dnyaneshwar Karale, and Prajwal Tanaji Honawale, Shri Bhairavnath Madhyamik Vidyalaya, Marathi Medium, Awasari.

**Third Prize:** Vaishnavi Kerbhau Nighot, Vaishnavi Laxman Gawade, and Anuja Sharad Gawade, Hirkani Vidyalaya, Marathi Medium, Gawadewadi.

## PUNE CITY SCHOOLS

### Drawing : \_\_\_\_\_

**First Prize:** Diyashree Karunakar Devadiga, Stella Maris Hish School.

**Second Prize:** Siddhi Sanjay Deokar, S.G. Thopte English Medium Secondary School.

**Third Prize:** Gauri Kerappa Chandanshive, H.H.C.P. High School for Girls and Junior College.

**Honorary Mention:** (1) Anuja Balasaheb Chalak, Huzurpaga Hish School, and (2) Chaitanya Vilas Pilane, Shree Vijay Vallabh Secondary School.

### Essay Writing: \_\_\_\_\_

#### ● Marathi -

**First Prize:** Not awarded

**Second Prize:** Rohit Madhukar Chaure, Modern High School for Boys.

**Third Prize:** Kshitija Tanaji Bansode, Nutan Marathi Vidyalaya Girls' High School and Junior College.

#### ● English-

**First Prize:** Shabbir Ali Kaderi, Air Force School.

**Second Prize:** Rushil Kulkarni, V.P. Magarpatta City Public School.

**Third Prize:** Raavi Saxena, St. Mary's School.

**Honorary Mention:** (1) Ashwath Sameer Bhisey, Loyola High School and Junior College; (2) Sahil Santosh Machkar, Pawar Public School, Nanded City; and (3) Madhur Vaidya, S.P.M. English School.

### Science Quiz : \_\_\_\_\_

**First Prize:** Ayush Jha, Chahel Singh, and Ayush Kerhalkar, Delhi Public School.

**Second Prize:** Anjali Niraj Tyagi, Harsh Ullas Nair, and Arnav Rajat Singhal, The Bishop's Co-Education School.

**Third Prize:** Aryan Mahjan, Spruha Baviskar, and Youkta Mandavkar, Vikhe Patil Memorial School.

### Poetry Writing : \_\_\_\_\_

#### ● Marathi -

**First Prize:** Priya Prasad Thakurdesai, Bharat English School.

**Second Prize:** Bhargavi Mayuresh Deshpande, Ahilyadevi High School for Girls.

**Third Prize:** Not awarded.

**Honorary Mention:** Mansi Pradeep Daundkar, H.H.C.P. High School for Girls and Junior College.

#### ● English -

**First Prize:** Khyati Anand Yadav, Crescent High School.

**Second Prize:** Prachi Nikhil Sahasrabudhe, Abhinav Vidyalaya High School.

**Third Prize:** Tanishq Rahul Bhand, City Pride School.

### Best Team Award : \_\_\_\_\_

V.P. Magarpatta City Public School.



## National Workshop on Introduction to Solar Astrophysics (Astronomical Data Analysis Series)



The National Workshop on Introduction to Solar Astrophysics was conducted at the Department of Physics, St. Xavier's College for Women, Aluva, during March 2 – 3, 2019. This workshop was the fourth in the series organised by the Academy of Physics Teachers (APT), Kerala, and was sponsored by IUCAA. Also, this was conducted under the Teaching Learning Centre in Astronomy and Astrophysics at IUCAA, of the Ministry of Human Resources Development, Government of India, under the Pandit Madan Mohan Malviya National Mission on Teachers and Teaching Scheme, to train teachers and students from various colleges in Kerala in data analysis in the field of Astrophysics. The workshop targeted young researchers, post-graduate students and teachers, and the participants registered included 33 students and 16 teachers and research scholars.

Sheena Xavier (Head, Department of Physics) welcomed the resource persons and participants, and Sr. Stella (Vice Principal) inaugurated the workshop, which consisted of lectures in the mornings and hands-on sessions in the

afternoons. The resource persons were: Durgesh Tripathi (IUCAA), Sreejith Padhinjatteri (IUCAA), Sargam Muley (IUCAA), and Aveek Sarkar (PRL, Ahmedabad).

During the morning sessions, Durgesh Tripathi, along with Aveek Sarkar covered the topics on various aspects of Sun, Solar Dynamo, Physics of Solar Atmosphere and upcoming Indian Solar Mission Project 'Aditya-L1'. In the afternoon sessions, there were Solar Data Analysis hands-on sessions, tackling simple projects using Solar Data. On the first day, Sreejith Padhinjatteri and Sargam Muley introduced the Linux OS and Interactive Data Language (IDL) with its basic commands for handling the data analysis. Real solar observation data were taken from Solar Dynamics Observatory, and its analysis techniques were explained to the participants. On the second day afternoon session, the participants got an opportunity to work on Solar Data, i.e., sun spot number, solar flux, etc. over the period of ~ 100 years, etc.

During the valedictory session, the participants gave their feedback and suggestions. According to them, the workshop was well organized, and useful and helpful in their on-going research and projects. Participants also suggested to have long duration (minimum one week) of the programmes for better effectiveness, covering more data analysis and more advanced topics including research topics. The feedback received from them suggested that the conference was a great success and achieved its stated objectives. Durgesh Tripathi, Sujatha N. V. (St. Xavier's College), and Joe Jacob (Newman College, Thodupuzha) were the coordinators of the workshop.

## Winter School in Astronomy, Astrophysics and Cosmology

National level Winter School in Astronomy, Astrophysics and Cosmology was organised during January 7 - 13, 2019, by the Department of Physics, Gauhati University (GU), Guwahati, and was sponsored by IUCAA. The objective was to discuss the current trends of research in theoretical and observational astrophysics and cosmology, and to train students of physics and astronomy, who would be potential participants in astrophysical studies in the new era of extremely large telescopes. The school was inaugurated by Mridul Hazarika (Vice Chancellor, GU).

There were 30 student participants from the Universities of North-East India, Uttarakhand, Kolkata and Delhi.

The speakers were: Ganesh Srinivasan (RRI, Bengaluru), Ram Sagar (IIA, Bengaluru), Padmakar Singh Parihar (IIA, Bengaluru), Dhruba Jyoti Saikia (IUCAA), Asoke Kumar Sen (Assam University, Silchar), Brijesh Kumar (ARIES, Nanital), Sukanta Deb (Cotton University, Guwahati), Biman J. Medhi (GU), and Sanjeev Kalita (GU). Topics such as Physics of Stars, Multi-wavelength Astronomy, Astronomical Instrumentations, Star Formation, Solar System, General Relativity and Black Holes, Quasars, Cosmology, Variable Stars and Light Curves, Astronomical Data Analysis, etc. were discussed. Sanjeev Kalita, Biman J Medhi, and Ranjeev Misra (IUCAA) were the coordinators



# National Student Seminar on Frontiers in Physics

The National Student Seminar on Frontiers in Physics (FiP) is a series, where faculty members, scientists, and industrialists from all over India and abroad are invited to give lectures, and interact with students in frontier areas of physics. This is an annual event, which is organised by the members of Astro Club, Department of Physics, Fergusson College (FC), Pune. For the 12th series of FiP, conducted during February 1 - 2, 2019, an Observational Astronomy session was arranged for the participants on the evening of the first day.

The sessions were initiated by Jitendra Joshi and Soham K. (both students of FC), with an introduction to the night sky and the basics of astronomy, and use of star dial. This was followed by an introduction to Stellarium. Manish Hirey conducted the main observation session, which included basics of telescopes and a hands-on approach on a 9.5 inch Cassegrain telescope and use of photometer, and CCD. The observatory dome fascinated many participants. Raka Dabhade (Head, Department of Physics, FC), and Ranjeev Misra (IUCAA) were the coordinators.

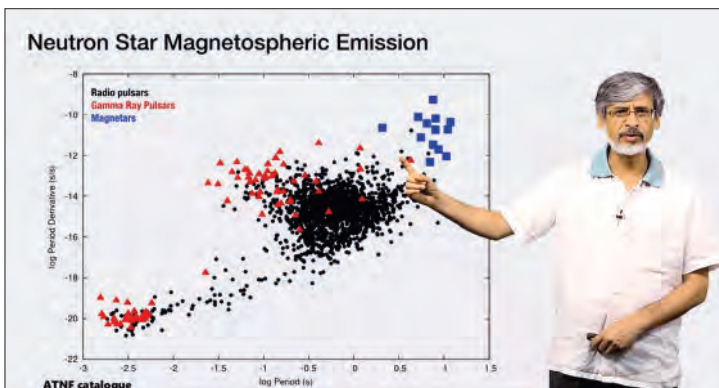
## Workshop on Astronomy and Astrophysics



A Workshop on Astronomy and Astrophysics was held at Sikkim University, Gangtok, during March 29 - 31, 2019. It was inaugurated by the Vice-Chancellor Avinash Khare, and the participants, about 60, came largely from Gangtok and nearby

places, and a few from North Bengal. The topics covered included: Stars and Stellar Systems by Sukanta Deb (Cotton University, Guwahati), Galaxies and their Evolution by Kanak Saha (IUCAA), Active Galaxies and Aspects of Observational Astronomy by Dhruba J. Saikia (IUCAA), Gravitation and Cosmology by Debasish Borah (IIT, Guwahati), and Gravitational Waves and Dark Matter by Bikash Paul (North Bengal University, Siliguri). On the last day of the workshop, there was an enlightening evening talk by Avinash Khare on the historical development of the General Theory of Relativity, examining largely the contributions of Einstein and Hilbert. The workshop was coordinated by Subir Mukhopdhyay (Sikkim University), and Dhruba J. Saikia.

## Annual Refresher Programme in Teaching (ARPIT 2018)



The National Resource Centre at IUCAA has developed a broad-based course on astronomy and astrophysics for the Annual Refresher Programme in Teaching (ARPIT 2018), consisting of 57 videos spread across 11 modules, along with

multiple-choice questions for each video, and suggestions for further readings. These videos have been offered on SWAYAM platform for college/university teachers. The modules covered a wide range of topics, which included: General Theory of Relativity, Gravitational Waves, Quantum Gravity, Cosmology and Large-Scale Structure, Galaxies and Clusters of Galaxies, Physics of Compact Objects, the Sun, Solar Wind and Planetary Systems, Observational Astronomy, Astronomy from Archival Data, Time-Domain Astronomy, and Astrostatistics. These video presentations were made by 27 resource persons from 11 institutions of higher education and research, spread across the country. They have highlighted the recent developments in the respective areas, touching upon the basic required pedagogy, and emphasising emerging areas in the field. Over 1300 participants registered for the course, which was well received with a rating of 4.8 out of 5.



## Activities of Teaching Learning Centre

### Workshop on Developing Astronomy-Themed Experiments



The Workshop on Developing Astronomy-Themed Experiments, which would help to get the subject into physics laboratories at under-graduate and post-graduate levels, was held at IUCAA, during June 18 - 20, 2018. There were about 50 astronomers and college/university teachers from various parts of the country,

actively participating in the workshop, which discussed experiments on a number of themes at radio, optical and x-ray wavebands. The themes included: Properties of Electromagnetic Radiation, Optics in Astronomy / Telescopes, High Energy and Gravitational Waves Astronomy, Positional Astronomy and Orbital Mechanics, Spectroscopy and Spectral Analysis, Radio Antennas, Interferometry, and Astronomical Data Analysis. This workshop was coordinated by Samir Dhurde (IUCAA), Priya Hasan (Maulana Azad National Urdu University, Hyderabad), and Joe Jacob (Newman College, Thodupuzha) with several groups of astronomers including ASI-POEC members as resource persons.

## Workshop on Radio Observations using Horn Antenna

Faculty members from half a dozen institutions participated in the Workshop on Radio Observations using Horn Antenna at IUCAA, during March 9 - 11, 2019. The goal of this workshop was to build a horn antenna and a complete system to detect the HI line of neutral atomic hydrogen at 1420.4 MHz coming from the Galactic plane, and understand the physics behind it. In this workshop, participants assembled all the mechanical parts to construct the horn antenna along with the mount, and connected all the front-end electronics to detect the hydrogen line. Once the antenna was ready, it was pointed towards the Galactic plane, and the participants could see the spectrum on the screen. There was a shift in the 1420 MHz line compared to the rest



frequency due to the rotation of our Galaxy. This was done under the technical supervision of IUCAA Radio Physics Laboratory team, particularly Jameer Manur and Ashish Mhaske. The workshop was coordinated by Sayali Avachat, Joydeep Bagchi and Manojendu Choudhury (all from IUCAA), who were also resource persons.



## Workshop on Night Sky Photometer Fabrication



The Workshop on Night Sky Photometer Fabrication was held at IUCAA, during March 12 - 16, 2019, and attended by faculty members from 5 institutions. Using a design developed by the

Instrumentation Laboratory of IUCAA, the participants assembled all the electronic components to make the night sky photometer. The IUCAA resource persons taught them the art of soldering and assembling the various components. Once the photometer was ready, the participants calibrated the instrument and made observations of the sky and bright stars using a small telescope, on both the terrace at IUCAA, and at the site of the IUCAA Girawali Observatory. This workshop was carried out under the technical supervision of Bhushan Joshi and Vilas Mestry (both from IUCAA) with Ranjan Gupta (IUCAA), and Arvind Paranjpye (Nehru Planetarium, Mumbai) being the additional resource persons. The workshop was coordinated by Sayali Avachat, Manojendu Choudhury and Ranjan Gupta.

## NRC and TLC Staff



The activities of both IUCAA NRC and TLC have been overseen by Dhruva J. Saikia (Head, NRC and TLC), with Sanjit Mitra (as Faculty Coordinator), Manojendu Choudhury (as Academic Coordinator), Sayali Avachat (as Senior Research Staff), Preethi K. and Chaitra Narayan (as Project Assistants), and Aniket Kadu and Shivraj K. Kshatriya (as Interns). Suchit Hasabnis (SPPU), Vivek Kannadi and Parmeshwar S. Yadav (IISER Pune), and Kamala Kannan (IIT Madras) helped in recording the videos.

## Mini-School on X-ray Astronomy Data Analysis



The Department of Physics, Providence Women's College, Kozhikode, in collaboration with Academy of Physics Teachers (APT), Kerala and IUCAA, organized a Mini-School on X-ray Astronomy Data Analysis for the benefit of college teachers, during May 22 - 26, 2018. The main aim of the mini-

school was to make the participants aware of the theoretical and observational aspects of Multi-wavelength Astronomy and the present challenges in this field. The number of participants was restricted to twenty. The mini-school focused on hands-on sessions only, and the detailed data analysis of the X-ray payloads of AstroSat, LAXPC and SXT were carried out. Participants were divided into groups, and AstroSat data of X-ray objects like, LMXBs, AGNs, etc. were assigned to each group. By the end of the school, participants were able to complete the preliminary analysis, and come up with early results. Savithri Ezhikode (St. Thomas College, Kozhanchery), Ranjeev Misra (IUCAA), Sneha Prakash (Christ University, Bengaluru), and Jithesh V. (IUCAA) were the resource persons. The coordinators of the school were Jeena Karunakaran (Providence Women's College), and Ranjeev Misra.



## Regional Meeting on Research in Astronomy: Opportunities and Challenges



The 5th edition of the Regional Meeting on Research in Astronomy: Opportunities and Challenges was held during February 8 - 9, 2019 at the Department of Physics, Cochin University of Science and Technology (CUSAT), Kochi.

The meeting was conducted on a unique platform for aspiring regional researchers to meet and present their research work, and also to interact with eminent scientists in the field. There were a total of 44 participants, consisting of faculty members, research scholars and post-graduates students from Universities, Colleges and Institutions in the state of Kerala. T. Padmanabhan and Kandaswamy Subramanian (both from IUCAA) gave special lectures on advanced challenges in Astronomy. The topics of the lectures include: Gravitation, Cosmology, Stellar Physics and Inter-Stellar Medium, Infrared, Optical and X-ray Astronomy, Solar System, MHD, AGNs, Statistics, and Machine Learning. The coordinators of the meeting were Charles Jose, Titus Mathew (both from CUSAT), and Ranjeev Misra (IUCAA).

## Public Outreach Activities

### Workshop on Telescope Making

A Workshop on Telescope Making was conducted at the Department of Physics, Visva-Bharati University (VBU), Santiniketan, during March 18 - 20, 2019. The workshop was mainly aimed towards students, and the main objective was to build one's own telescope and watch the night sky. Also, there were science popularization lectures, sky map reading followed by sky watching sessions and demonstration of scientific principles through science toys. There was also a discussion session, in which the IUCAA Public Outreach team interacted with teachers of nearby secondary and higher secondary schools on how astronomy and in general, science can be taught with fun.

Members of IUCAA Public Outreach team: Neha Deshpande, Samir Dhurde, Rupesh Labade, Maharudra Mate



Shivani Pethe, Tushar Purohit, and Sonal Thorve, were the resource persons. Debi Prosad Duari (Director, M.P. Birla Planetarium, Kolkata) delivered a popular talk for the young minds on Concepts and Challenges in Astronomy and Astrophysics, followed by a talk on Telescopes by Samir Dhurde. Around 60 students and 15 teachers from nearby schools, and around 85 BSc and MSc students and faculty members of various departments of VBU participated in the workshop.

The hands-on telescope making activity was one of the most enjoyed sessions of the event. The participants built 35 telescopes (both 2 inch refractor type and 5 inch reflector type) with the help of IUCAA members, which provided a deeper insight into the working of a telescope. The workshop was funded by IUCAA and VBU. Sudipta Das (VBU) and Samir Dhurde were the coordinators of the workshop.



## Workshops on Telescope Making, at Goa and Latur

IUCAA Science Outreach team, in collaboration with Vigyan Parishad, Goa, conducted a Workshop on Telescope Making, at Science Film Festival, Goa, during January 17 - 20, 2019. Altogether, 200 small refracting telescopes were made by students of classes VI to XII. Tushar Purohit was the resource person.

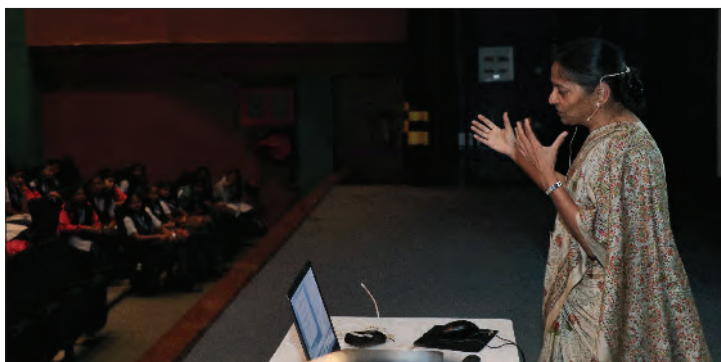
During February 22 - 24, 2019 a similar workshop was organised at Latur Science Centre. Twenty six large (5 inch) reflector telescopes were made by school teachers.

## Workshop for Teachers from Rural Schools near IGO, at IUCAA

A two day workshop for secondary school teachers from rural areas in and around IUCAA Girawali Observatory (IGO) was held during January 23 - 24, 2019, at IUCAA. On the first day, there were demonstrations of science toys along with hands-on activities related to the topics on sound, light, and magnetism. This was followed by introduction to the optics and telescopes with an evening sky-watching session. The activities on the second day, included instructions on



textbook astronomy, hands-on astronomy, and role plays. The workshop was coordinated by Rupesh Labade and Sonal Thorve (both from IUCAA).



## International Day for Women in Science, at IUCAA

On the occasion of the International Day for Women in Science, IUCAA Science Outreach personnel organised a special event for girl students from Marathi medium schools in and around Pune, on February 11, 2019, at IUCAA. Pushpa Khare, senior astrophysicist, delivered an inspirational talk on Let us Know Our Universe. This was followed by a talk on Astronomy: Do it Yourself by Sonal Thorve.

A video scripted and recorded by Science Outreach personnel, featuring women astronomers at IUCAA was published on this occasion. The video shares a brief history of women in astronomy, current scenario and future prospects and challenges. Videography was coordinated by Ishan Shinde (IUCAA), and the event was coordinated by Samir Dhurde (IUCAA) and Sonal Thorve.

## Celebrating Women in Astronomy, at Fergusson College, Pune

To celebrate International Day for Women in Science, Astro club of Fergusson College, Pune, had organised a series of guest talks on Astronomy by women astronomers on February 11, 2019. As a part of the series, Sonal Thorve delivered a talk on Astronomy Outreach: Challenges and Solutions.

## Talk, at Rani Lakshmibai Mulinchi Sainiki Shala, Mulshi

IUCAA Public Outreach team visited Rani Lakshmibai Mulinchi Sainiki Shala, Mulshi (near Pune) on January 9, 2019. A talk on Space Science with demonstration was delivered to class X students by Sonal Thorve. Rupesh Labade demonstrated science toys based on themes sound, light, and pressure to students of classes VI to IX. This was followed by a sky watching session conducted by Tushar Purohit (IUCAA). About 300 students along with teachers enjoyed the sessions.



## 100 Hours of Astronomy

On the occasion of 100 Years of International Astronomical Union, IUCAA participated in the worldwide celebration of "100 Hours of Astronomy" on January 11 and 12, 2019. The sky watching programmes were arranged for specific community groups. On the first day, the sky watching was arranged for the staff of the Savitribai Phule Pune University (SPPU) and their families in the university campus, in collaboration with the Science Park of the university. On the second day, sky watching programme was arranged for performing artists from the Department of Performing Arts of the SPPU in the Science Park of IUCAA. In total, about 800 people visited and appreciated the programmes.



## Ignite, at BITS - Pilani, Hyderabad

Nirmaan Organization from BITS - Pilani, Hyderabad organised an event: Ignite, on February 10, 2019, aimed at providing value-based education to the under-privileged kids, and helping them explore while they learn. An early morning telescope observation session, hands-on science activities and demonstrations were conducted, in which about 50 student participants enjoyed the programmes. With the help of local teachers and volunteers, Sonal Thorve and Maharudra Mate (IUCAA), conducted science toys demonstrations based on Newton's laws, electricity, and magnetism, and helped the students learn these concepts by making related toys.

## Workshop on Science Toys Demonstration and Basic Astronomy, at Satara

Members of IUCAA Public Outreach team visited Jayaramswami Vidyalaya, Khatav, Satara in Maharashtra, on February 14 and 15, 2019. With the help of local teachers, the team organised and conducted science toys demonstrations and sky-watching sessions for the students and people around the village. It was a first time experience for most of the villagers to observe sky with a telescope. About 1,600 spectators enjoyed and appreciated the sessions.



## Workshop on Basic Astronomy for Teachers, at IISER - Pune

As a part of STEP for STEM programme, organised by Indian Institute of Science Education and Research (IISER), Pune, lecture demonstration sessions on Knowing Our Universe and hands-on astronomy were conducted on February 26 and March 1, 2019, by Sonal Thorve. About 100 middle-school teachers from Pune district participated in this programme.

## Workshop on Fundamental Science, at Nagaland

A workshop on Fundamental Science was organised by IUCAA Public Outreach team to students of classes from VI to X, in and around Kohima, Nagaland, during March 11 - 14, 2019. Fundamental principles of science were demonstrated with the help of science toys. Topics like conduction of heat, generation of sound, effects of pressure, and Newton's laws of motion were covered. About 600 students from four different schools enjoyed the activities. Shivani Pethe (IUCAA) coordinated and conducted the workshop, with the help of Tanushree Borundia from Shibhumi, Bengaluru.



## Equinox Event, at New English School, Tilak Road, Pune

On the occasion of Vernal Equinox on March 21, 2019, IUCAA Science Outreach team, in collaboration with New English School, Tilak Road, Pune, conducted a workshop on measuring the circumference of the Earth using Eratosthenes method. Sixteen students of classes VIII and IX, along with a teacher, participated in a three-hour long session. Students calculated the circumference of the Earth with an error of less than 3%. Shivom Gupta (IUCAA) was the resource person.

## Lecture on Astronomy, at Mukhtangan Exploratory, Pune

As a part of summer camps, organised by Mukhtangan Exploratory, Pune, a lecture on Celestial Sphere and Sky Map Reading was delivered by Samir Dhurde on March 28, 2019. About 50 school students attended and enjoyed the session.

## Workshop on Astronomy, at IIT, Gandhinagar

A Workshop on Astronomy was conducted at the Indian Institute of Technology, Gandhinagar, during March 7 - 8, 2019, with Samir Dhurde as the resource person. He gave a talk on Astronomy Facilities in India, emphasising on the career opportunities to science and engineering graduates. The telescope at the IIT Astronomy Club was also overhauled, and a public sky watching show was conducted.

## Second Saturday Lectures

January 5, 2019: Jayant Narlikar (IUCAA), on Cosmic Illusions.

February 9, 2019: Rupesh Labade, and Shivani Pethe (both from IUCAA), on Science Toys Demonstration.

## Other Events

- The annual meeting of the Astronomical Society of India (ASI) was held at the Christ (Deemed to be) University, Bengaluru, during February 16 - 19, 2019. The Public Outreach and Education Committee (ASI - POEC) was given the Zubin Kumbhavi Award for Public Outreach and Education in Astronomy and allied fields. Samir Dhurde, Member - Secretary of ASI - POEC received the award along with the team.

- On February 26, 2019, Samir Dhurde gave a talk in Marathi on Mathematics and Astronomy in Geography, at an event organised for teachers by the Bhoogol Shikshan Mandal, Pune.

## Other Regular Events

The IUCAA Public Outreach team has conducted 5 science toys workshops, 4 basic astronomy workshops, and 8 campus visits with an approximate outreach to about 900 people.



## Visitors

January - March 2019

Namuna Adhikari, Rana Adhikari, Sagar Adhikari, Dharam Vir Ahluwalia, Bobomurat Ahmedov, Moumita Aich, Kevin Alabarta, G. C. Anupama, C.V. Anusree, K.G. Anusree, Raghav Arora, Sukhdev Arsule, Prasiddha Arunachalam, Abhay Ashtekar, Saji Augustine, Kalyani Bagri, Sanjay Bagul, Sharan Banagiri, Arunima Banerjee, Smaranika Banerjee, Srimanta Banerjee, Kalyani Bangar, S. N. Bankhele, Vinod Baravkar, Pooja R. Barman, Ranojit Barman, Samuzal Barua, Sudhanshu Barway, Prakash Basyal, Satyaranjan Behera, M.D. Benoy, Sourav Bhadra, Naseer Iqbal Bhat, Rashmi Bhattacharjee, Debbijoy Bhattacharya, Yashpal Bhulla, G.R. Bhuvana, Aparna Bisht, Dibyajyoti Bora, Anshuman Borgohain, Sahebrao Borkar, Hritam Chakraborty, Nand Kumar Chakradhari, Koustav Chandra, Sunil Chandra, Philip Charles, Ayan Chatterjee, Goutami Chattopadhyay, Surajit Chattopadhyay, Virander S. Chauhan, Daya Nidhi Chhatkuli, Sourav Roy Chowdhury, Haeun Chung, Mark Coles, Abhishek Das, Susmita Das, Arnab Dasgupta, Shamik Datta, Ujjal Debnath, Kabita Deka, I.B. Singh Deo, Moon Moon Devi, L. S. Devkar, Ramesh Dhobale, Payaswinee Dhoke, Leena Dili, Dipak Doiphode, Namdeo Doke, Suprio Dubey, Arunima Dutta, Jibitesh Dutta, Bhooshan Gadre, Poshak Gandhi, Akash Garg, V. Gayathri, B.R. Geethika, Joji George, Mathew George, Prabir Gharami, Nilkantha Namdev Gholap, Koushik Ghosh, Tathagata Ghosh, Tuhin Ghosh, Rupjyoti Gogoi, Ajay Gopali, Bhaskar Goswami, Milind Gowardhan, R. Greeshma, Hitesh Kumar Gulati, Mubashir Hamid, Giles Hammond, K.P. Harikrishnan, Raktima

Hazarika, Martin Hendry, Ik Siong Heng, Mathew Hilton, Vilas Ingale, Bala Iyer, Joe Jacob, Rinku Jacob, Rohan Jadhav, Dhairyashil Jagadale, Preshanth Jagannathan, Chetana Jain, Rajnish Jain, Tamanna Jain, V. K. Jain, Antidong Jamir, Manasa P. Janin, P. Jishnu, Sharda Keshav Jogadand, A. S. Joshi, Kamal Joshi, Minu Joy, Shilpa Kadam, Nirmal Kaipachery, Ashwini Kale, Mohan Kale, U. R. Kamble, Shashi Kanbur, Chittatosh Karewar, Soumyodipta Karmakar, Preethi R. Karpoor, Parashmoni Kashyap, Krishnaswamy Kasturirangan, Khagendra Katuwal, Tejpreet Kaur, Van Marten Kerkwijk, Rabina Khadka, Sheeraz Ahmad Khanday, Avinash Khare, Bijaya Kharel, Yogesh Rajesh Khemka, Ashish Khokar, K.V. Krishnapriya, Sumeet Kulkarni, M. Jagadesh Kumar, Rajiv Kumar, Rakesh Kumar, Richa Kundu, Aditi Kurre, Philippe Landry, B. R Lokhande, Anamitra Mahanta, M. Mahith, Sunil Malik, Zahoor Ahmad Malik, Labani Mallick, D. Mancharkar, Suvadip Mandal, Amol Mandilkar, P.V. Manjusha, Sonal Mansingh, Aaqib Manzoor, Bivudutta Mishra, Chandrakant Mishra, Shrish Misra, Dipanjan Mitra, Abhishek Mohapatra, Pierluigi Monaco, Rajesh Mondal, Dipanjan Mukherjee, Pulok K. Mukherjee, Sajal Mukherjee, Subroto Mukherjee, Suvodip Mukherjee, Masum Murshid, K. Ram Chandra Murthy, J. N. Nagaraj, Navmi Athmaram Naik, Ganga R. Nair, Hemwati Nandan, Rajesh Nayak, Shefali Negi, Shamin Padalkar, Archana Pai, Supratik Pal, A. C. Pandey, Divya Pandey, Mahadev Pandge, P.N. Pandita, Nidhi Pant, Uma Papnoi, Ajith Parameswaran, Manu Paranjape,

Arvind Paranjpye, Krishna Mohan Parattu, Ashish Patel, K.D. Patil, Pravin Patole, Rohan Pattnaik, Sanjay Papat Pavale, Khun Sang Phukon, Anil Prabhakar, Karthik Prabhu, Raj Kumar Pradhan, Atul Kumar Prajapati, R.S. Pranjali, Jwala Prasad, Tushar Purohit, Frederick J. Raab, Aparna Raj, G. Rajalakshmi, T.R. Rajalakshmi, Mainpal Rajan, A. D. Rakshe, Rambir, Sandeep Rana, Adarsh Ranjan, A. R. Rao, Rajan Ravindran, Divya Rawat, Subharthi Ray, Javlon Rayimbaev, David Reitze, Gaurab Rijal, Prabir Rudra, G.R. Sabareesh, Sonali Sachdeva, T. Sahay, P. Muhammad Sajeer, Gauranga Charan Samanta, Prasant Kumar Samantray, Aveek Sarkar, Biplob Sarkar, Mukesh Satankar, Amrit Sedain, Anand Sengupta, Nigar Shaji, Saran Shaju, Ajay Sharma, Asha Sharma, Deepak Shinde, Akriti Singh, D. P. Singh, Jyoti Singh, Manju Singh, Narinder Pal Singh, Parampreet Singh, Ramesh Sinha, Surendra Nadh Somala, Balu Sreedhar, K.R. Sreenivasan, V. Sreepriya, Sharada Srinivasan, Amit Srivastava, Arun Srivastava, Ravi Subrahmanyam, Padma Subrahmanyam, Tomomi Sunayama, S. Sunil, Kousik Sur, Prayas Sutar, Subhashree Swain, Amit Tamrakar, Vibeizotuo Tetso, Archana Thakur, Rakesh Thokal, Julie Jacob Thomas, Neal Thomas, Lekshmi Thulasidharan, Lakshmi Kant Tiwari, Prabhakar Tiwari, S.K. Tripathy, Jitendra Trivedi, Sandip Trivedi, Malavika Unni, S. T. Khaiminthang Vaiphei, Manoj Varma, K. R. Venugopal, Ramasamy Venugopal, Murli Manohar Verma, Aditya Vidhate, Angelos Vourlidis, Prashant Walke, P. S. Wayker, J.S. Yadav, and Urjit Yajnik.

# Visitors Expected

## April 2019

Sheelu Abraham, Marthoma College, Nilambur; Oluwashina Adegoke, IISc, Bengaluru; Md. Ramiz Aktar, IIT, Guwahati; G.C. Anupama, IIA, Bengaluru; C.V. Anusree, Government College, Madappali; Anuvab Banerjee, SNBNCBS, Kolkata; Sambaran Banerjee, University of Bonn, Germany; Srimanta Banerjee, TIFR, Mumbai; Samuzal Barua, Hojai College; N. S. Benerji, RRCAT, Indore; Varun Bhalerao, IIT, Mumbai; Harshitha Bhat, St. Joseph's College, Bengaluru; Ayan Bhattacharjee, SNBNCBS, Kolkata; Dipanweeta Bhattacharyya, IIA, Bengaluru; Maitraya Kanta Bhattacharyya, IISER, Kolkata; Sudip Bhattacharyya, TIFR, Mumbai; Yashpal Bhulla, Pacific University, Udaipur; G.R. Bhuvana, Christ University, Bengaluru; Kamal Bora, IIT, Hyderabad; Sandip Chakrabarti, Indian Centre for Space Physics, Kolkata; Manoneeta Chakraborty, IIT, Indore; Swadesh Chand, Guru Ghasidas Central University, Bilaspur; Arka Chatterjee, SNBNCBS, Kolkata; Debjit Chatterjee, Indian Centre for Space Physics, Kolkata; Ritaban Chatterjee, Presidency University, Kolkata; Sangita Chatterjee, Jadavpur University, Kolkata; Indranil Chattopadhyay, ARIES, Nainital; Dennis Coyne, Caltech, USA; Santabrata Das, IIT, Guwahati; Patrick Dasgupta, University of Delhi; Raya Dastidar, ARIES, Nainital; Sudeb Ranjan Datta, IISc, Bengaluru; Dipak Debnath, Indian Centre for Space Physics, Kolkata; Kabita Deka, Tezpur University; Prasun Dhang, IISc, Bengaluru; Payaswinee Dhoke, Dharampeth M.P. Deo Memorial Science College, Nagpur; Indu Kapla Dihingia, IIT, Guwahati; Broja Gopal Dutta, Rishi Bankim Chandra College, Naihati; Anjasha Gangopadhyay,

ARIES, Nainital; Edgar Gasperin Garcia, University of Lisbon, Portugal; Akash Garg, Jamia Millia Islamia, Delhi; B.R. Geethika, Providence Women's College, Kozhikode; Koushik Ghosh, Burdwan University; Subham Ghosh, IISc, Bengaluru; Tathagata Ghosh, IIT, Kanpur; Joseph A. Giaime, Caltech, USA; V. Girish, ISRO, Bengaluru; G.K. Goswami, Kalyan P.G. Autonomous College, Bhilai; Shivangi Gupta, PRL, Ahmedabad; Priyanka Jalan, ARIES, Nainital; Arghajit Jana, Indian Centre for Space Physics, Kolkata; K. Jeena, Providence Women's College, Kozhikode; A. S. Joshi, RRCAT, Indore; Arti Joshi, ARIES, Nainital; Shubham Kala, GKV, Haridwar; Mohan Kale, DCSEM, DAE, Mumbai; Surajit Kalita, IISc, Bengaluru; Rukaiya Khatoon, Tezpur University; Yogesh Rajesh Khemka, BITS-Pilani, Hyderabad; K.V. Krishnapriya, Providence Women's College, Kozhikode; Nagendra Kumar, IISc, Bengaluru; Nagendra Kumar, MMH College, Ghaziabad; Rajiv Kumar, ARIES, Nainital; Rakesh Kumar, IPR, Ahmedabad; Kavita Kumari, University of Delhi; Neeraj Kumari, PRL, Ahmedabad; Michael Landry, LIGO Hanford Observatory, USA; Amit Kumar Mandal, Christ University, Bengaluru; Samir Mandal, IISST, Thiruvananthapuram; Arun Mangalam, IIA, Bengaluru; P.V. Manjusha, Government College, Madappali; Arijit Manna, Midnapore City College Kuturiya; N.P.S. Mithun, PRL, Ahmedabad; Soumen Mondal, Jadavpur University, Kolkata; Tushar Mondal, IISc, Bengaluru; Purba Mukherjee, IISER, Kolkata; Banibrata Mukhopadhyay, IISc, Bengaluru; Nikhil Mukund, AEI, Hannover, Germany; Masum Murshid, Aliah University, Kolkata; Sachindra Naik, PRL, Ahmedabad; Hemwati Nandan, Gurukula Kangri Vishwavidyalaya,

Haridwar; Anuj Nandi, ISRO Satellite Centre, Bengaluru; Prantik Nandi, SNBNCBS, Kolkata; Vineet Ojha, ARIES, Nainital; Indrani Pal, IIA, Bengaluru; M. C. Panda, New Delhi; Divya Pandey, NIT, Bhubaneswar; Ruchi Pandey, SNBNCBS, Kolkata; S. K. Pandey, Pandit Ravishankar Shukla University, Raipur; Mahadev Pandey, Dayanand Science College, Latur; Sonal Patel, University of Mumbai; K.D. Patil, B.D. College of Engineering, Wardha; M. K. Patil, Swami Ramanand Teerth Marathwada University, Nanded; Biswajit Paul, RRI, Bengaluru; Nupur Paul, Jadavpur University, Kolkata; Devraj Pawar, RJ College, Mumbai; Anirudh Pradhan, GLA University, Mathura; Pratyush Pranav, Ecole Normale Supérieure De Lyon, France; Abdul Quddus, Aligarh Muslim University; Farook Rahaman, Jadavpur University, Kolkata; Mainpal Rajan, Jamia Millia Islamia, Delhi; Purna Rana, IIA, Bengaluru; Sandeep Rana, IISER, Mohali; Vikram Rana, RRI, Bengaluru; Priyanka Rani, IIA, Bengaluru; A. R. Rao, TIFR, Mumbai; Divya Rawat, IIT, Kanpur; Sananda Raychaudhuri, Bose Institute, Kolkata; B. Eswar Reddy, IIA, Bengaluru; Sunder B. Sahayanathan, BARC, Mumbai; Nidhi Saini, University of Delhi; Sriram Sankar, IISST, Thiruvananthapuram; Piklu Santra, SNBNCBS, Kolkata; Shilpa Sarkar, ARIES, Nainital; Richard Savage, LIGO Hanford Observatory, USA; S. Seetha, ISRO, Bengaluru; Nigar Shaji, ISRO, Bengaluru; Saran Shaju, CUSAT, Kochi; Prateek Sharma, GKV, Haridwar; Mayur Shende, IISER, Pune; K. P. Singh, IISER, Mohali; Kuldeep Singh, ARIES, Nainital; Sekhar Sinha, Midnapore City College, Kuturiya; P. Sreekumar, ISRO, Bengaluru; C. S. Stalin, IIA, Bengaluru; Vipin Sudevan, IISER, Bhopal; Tomomi Sunayama,



Kavli Institute of Physics, Japan; Prayas Sutar, TISS, Mumbai; Subhashree Swain, Pondichery University; Shruti Tripathi, Saint Mary's University, Halifax, Canada; Santosh Vadawale, PRL, Ahmedabad; R. Vaisakh, IIT, Hyderabad; Bhargav Pradeep Vaidya, IIT, Indore; Manoj Varma, IIA, Bengaluru; Srinatha Venkatesha, Boyd Corporation, Bengaluru; Aditya Vidhate, BITS-Pilani, Hyderabad; Mukesh Kumar Vyas, ARIES, Nainital; and J. S. Yadav, TIFR, Mumbai.

### May 2019

Linn Abraham, St. Thomas College, Kozhencherri; G. K. Ankush, BITS-Pilani, Hyderabad; Tanwi Bandyopadhyay, Adani Institute of Infrastructure Engineering, Ahmedabad; Mukul Bhattacharya, University of Texas, Austin, USA; Kaustav Chatterjee, IISER, Mohali; Tanushree Chowdhury, Sri Venkateswara College, Delhi; Luca Cortese, The University of Western Australia; Subhadip De, NPL, New Delhi; Payaswinee Dhole, Dharampeth M. P. Deo Memorial Science College, Nagpur; Sarbari Guha, St. Xavier's College, Kolkata; Raja Guhathakurta, University of California, USA; Jyotishree Hota, NIT, Orissa; Josef Huber, ASTELCO, Germany; K. Indulekha, Mahatma Gandhi University, Kottayam; Joe Jacob, Newman College, Thodupuzha; Himani Jain, Maulana Azad NIT, Bhopal; Kanti Jotania, M.S. University of Baroda, Vadodara; Minu Joy, Alphonsa College, Pala; Shreejaya Karantha, Mahatma Gandhi Memorial College, Udupi; Sanika Khadkikar,

BITS-Pilani, Hyderabad; Pransh Khubchandani, Maulana Azad NIT, Bhopal; Mamta, SGTB Khalsa College, Delhi; Soma Mandal, Government Girl's General Degree College, Kolkata; Norbert Muller, ASTELCO, Germany; Sanjay Kumar Pandey, LBSPG College, Gonda; Shravani Pandit, Fergusson College, Pune; Rutu Parekh, Dhirubhai Ambani Institute of Information and Communication Technology, Gandhinagar. Devraj Pawar, RJ College, Mumbai; Annmaria J. Puthur, Vimala College, Trichur; B. S. Ratanpal, The M.S. University of Baroda, Vadodara; Saibal Ray, Government College of Engineering and Ceramic Technology, Kolkata; Sanjay Kumar Sahay, BITS-Pilani, Goa; Prasant Kumar Samantray, BITS-Pilani, Hyderabad; Sudipta Sarkar, IIT, Gandhinagar; Lydia Sertho, Vimala College, Trichur; Sparsh Singh, Maulana Azad NIT, Bhopal; H. Sree Kanth, University of Madras, Chennai; Praveer Tiwari, Washington State University, USA; S. K. Tripathy, Indira Gandhi Institute of Technology, Orissa; Deepak Vaid, NIT, Surathkal; Vijay Varma, Caltech, USA; and R. G. Vishwakarma, Universidad Autonoma de Zacatecas, Mexico.

### June 2019

G. Ambika, IISER, Tirupati; Dipanjali Behera, Indira Gandhi Institute of Technology, Orissa; Sumanta Chakraborty, IACS, Kolkata; Suresh Chandra, Amity University, Noida; Sourav Roy Chowdhury, Vidya Sagar College, Kolkata; Debabrata Deb, Indian Institute of Engineering Science and Technology, Howrah; Shantanu Desai, IIT, Hyderabad; Jayanta Dutta, IISER, Mohali; Bhola Ishwar, BRA Bihar

University, Muzaffarpur; Deepak Jain, Deen Dayal Upadhyaya College, New Delhi; Vinay Kashyap, Smithsonian Astrophysical Observatory, Harvard, USA; Nishikanta Khandai, NISER, Bhubaneswar; Ram Kishor, Central University of Rajasthan; Arun Kulkarni, BITS-Pilani, Goa; Rajesh Kumar, DDU Gorakhpur University; Kinjalk Lochan, IISER, Mohali; Bivudutta Mishra, BITS-Pilani, Hyderabad; Shrish Misra, NISER, Bhubaneswar; Nishant Mittal, Maharishi Dayanand College, Meerut; Arka Mondal, University of Calcutta, Kolkata; Arghya Mukherjee, University of Calcutta, Kolkata; Udit Narain, Meerut College; Amit Pathak, Banaras Hindu University, Varanasi; B. C. Paul, North Bengal University, Darjeeling; Ananta Charan Pradhan, NIT, Orissa; Samrit Pramanik, University of Calcutta, Kolkata; M. Xavier James Raj, VSSC, Thiruvananthapuram; T.R. Rajalakshmi, Mahatma Gandhi University, Kottayam; Shantanu Rastogi, DDU Gorakhpur University; Biplob Sarkar, The ICFAI University, Tripura; Somasri Sen, Jamia Millia Islamia, Delhi; T. R. Seshadri, University of Delhi; Joginder Sharma, BRC Budhana, Muzaffarnagar; Manvinder Pal Singh, SGTB Khalsa College, Delhi; Parijat Thakur, Guru Ghasidas Vishwavidyalaya, Bilaspur; Lekshmi Thulasidharan, Central University of Tamil Nadu; and Paniveni Udayashankar, Bengaluru.

### Long Term Visitors

Ajesh Gulati, TMT Project Office, USA; and David Hilditch, Adjunct Faculty, University of Lisbon, Portugal.

**Khagol (the Celestial Sphere)**  
is the quarterly bulletin of



We welcome your feedback at the following address:

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