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# KHAGOL

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## Contents...

Visit of the Scientific Advisory Committee	1 to 2
Research Highlights	
- A Mysterious Gamma-ray Emitting Galaxy System in Our Galactic Neighborhood - <i>Dr. Vaidehi Paliya</i>	2 to 3
- Of Galactic Spiral Arms and Traffic Jams - <i>Dr Arunima Banerjee</i>	4 to 5

Reports of Past Events	6 to 9
Welcome to, Farewell to, Colloquia and Seminars	10
Public Outreach Activities	11 to 17
Astronomy Centre for Educators	17 to 20
Visitors	20

## Meeting of the Scientific Advisory Committee



The Scientific Advisory Committee [SAC] meeting of IUCAA was held from April 22-26, 2024. The Committee consists of **Professor Phil Charles** [University of Southampton; Chair], **Professor Priyamvada Natarajan** [Yale University; Member], **Professor T. R. Seshadri** [Delhi University; Member], **Professor Ravi Sheth** [University of Pennsylvania; Member], **Professor Luc Simard** [University of Victoria; Member], **Professor P. Sreekumar** [Manipal Centre for Natural Sciences; Member], **Professor Alan Weinstein** [California Institute of Technology; Member] and **Professor R.**

**Srianand** [Director, IUCAA; Member Secretary]. Professor Priyamvada Natarajan could not attend the meeting.

The Committee received reports and presentations by faculty on all aspects of the activities of the Centre. The SAC members were given science presentations by a wide range of speakers from IUCAA and Associates. The SAC also had informal interactions with IUCAA's scientific staff, graduate students, postdoctoral fellows, visitors and personnel from the administration. The SAC members, in their report, were very

impressed with the accomplishments made by IUCAA in terms of fulfilling their mandate of bringing astronomical research and education opportunities to a wider geographical spread of Indian universities. They also provided various suggestions and recommendations to sustain and improve various activities of the Centre. IUCAA is in the process of developing a road map to implement these recommendations well ahead of the next SAC meeting scheduled two years from now.

## Research Highlights

### A Mysterious Gamma-ray Emitting Galaxy System in Our Galactic Neighbourhood

The photons are the main clues to unlock the mysteries of the Universe. The higher the energy of photons, the more violent the circumstances they originate. The most energetic are  $\gamma$ -ray photons with wavelengths smaller than an atomic nucleus's diameter. On Earth,  $\gamma$  rays are produced by nuclear fusion/fission,

lightning, and radioactive decay. In the Universe,  $\gamma$ -ray photons carry the signatures of the violent phenomena happening on various astronomical scales. This includes supernova remnants, pulsars, and pulsar wind nebulae in the Galactic environment and extragalactic relativistic jets associated with active

galactic nuclei [AGN].

The identification of  $\gamma$ -ray-emitting astrophysical objects is one of the crucial research problems in high-energy astrophysics. Furthermore, with the advent of multimessenger astronomy, the  $\gamma$ -ray source population has emerged as a promising candidate for the cosmic neutrinos detected with the IceCube observatory. Active Galactic Nuclei hosting closely aligned relativistic jets, also known as blazars, are the most abundant  $\gamma$ -ray emitters. The star-forming galaxies and pulsars have also been detected in the  $\gamma$ -ray band. However, thanks to the sensitive, high-resolution multiwavelength data provided by the latest wide-field sky surveys, the discovery potential to identify a  $\gamma$ -ray emitting, non-jetted source population remains high.

The right panel of Figure 1 shows "Kathryn's Wheel" as observed by the SuperCOSMOS H $\alpha$  survey. The image is a continuum subtracted to highlight the zones of star formation. The spectacular star-forming ring, triggered by galaxy collision, surrounding the central galaxy, ESO 179-13, is evident. The central galaxy shows little star formation, possibly stripped of gas due to interaction with the "bullet" galaxy, which itself is undergoing rapid star formation.

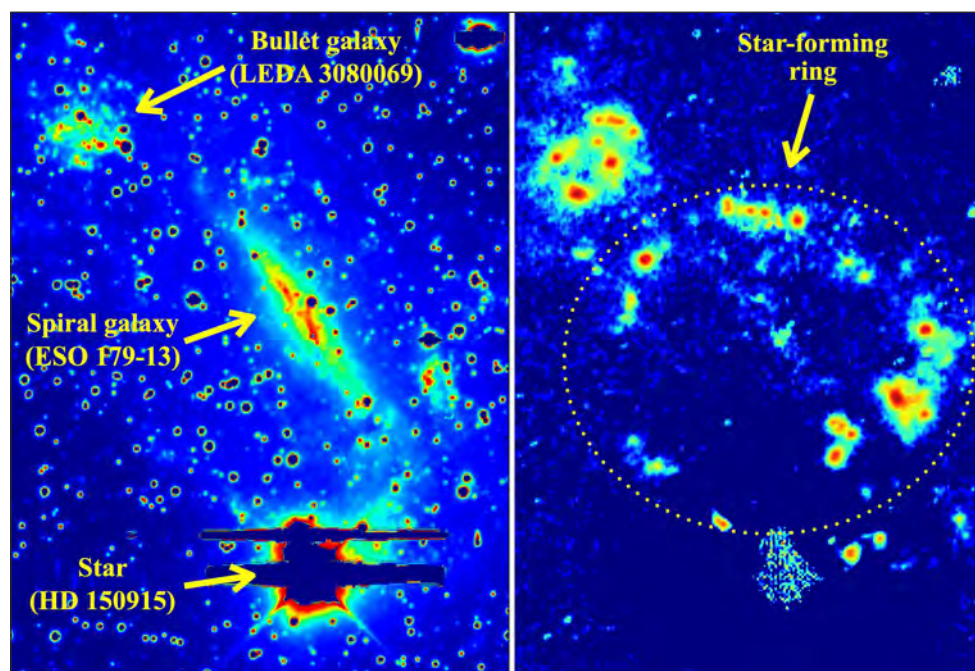


Fig. 1: [Left] The optical image of the gamma-ray emitting collisional ring galaxy system "Kathryn's Wheel". [Right]: Glowing hydrogen gas characteristic of star-forming regions is seen in the H-alpha band image of the same region, highlighting the ring of star formation. The dotted ellipse is added to guide the eye.



Recently, a collisional ring galaxy system, “Kathryn’s Wheel”, was discovered in the  $\gamma$ -ray band. This enigmatic system is located at a mere 30 million light years from the Milky Way. These extremely rare systems are formed when a smaller ‘bullet’ galaxy pierces through another larger galaxy close to its centre. The produced shock wave sweeps up and kicks the interstellar gas out of the system, leaving behind a ring of star-forming regions and a gas-poor galaxy. A computer simulation of the formation of such an enigmatic structure can be seen at [www.youtube.com/watch?v=GoD1MSveHgAG&t=88s](https://www.youtube.com/watch?v=GoD1MSveHgAG&t=88s). The best example of such a system is the Cartwheel galaxy. The optical image of “Kathryn’s Wheel” is shown in Figure 1 [left panel].

“Kathryn’s Wheel” is the nearest collisional ring galaxy system to the Milky Way. Located in the low-latitude ( $|b| = -8^\circ$ ) Galactic neighbourhood, the system includes a dwarf irregular galaxy, LEDA 3080069, acting as the ‘bullet’ that has collided with an edge-on, late-type, spiral galaxy ESO 179-13. The system also contains another dwarf irregular galaxy LEDA 3080065. The system has an overall physical size of  $\sim 15$  kpc and a total mass of  $6.7 \times 10^9$   $M_{\odot}$  (HI + stars). It was observed

as a part of the SuperCOSMOS  $H\alpha$  Survey of the Southern Galactic plane, which revealed the central galaxy, ESO 179-13, to be surrounded by a ring of star-forming knots and having a 6.1 kpc diameter. Based on the  $H\alpha$  and mid-infrared flux measurements, the integrated star formation rate (SFR) of the whole system is reported to be 0.2–0.5  $M_{\odot}$  per year, higher than that of the Large Magellanic Cloud [LMC]. The most luminous HII region in the system has an  $H\alpha$  luminosity of  $5 \times 10^{39}$  erg/s, comparable to supergiant HII region 30 Doradus in LMC, which is also a bright  $\gamma$ -ray emitter.

The right panel of Figure 1 shows “Kathryn’s Wheel” as observed by the SuperCOSMOS  $H\alpha$  survey. The image is a continuum subtracted to highlight the zones of star formation. The spectacular star-forming ring, triggered by galaxy collision, surrounding the central galaxy, ESO 179-13, is evident. The central galaxy shows little star formation, possibly stripped of gas due to interaction with the “bullet” galaxy, which itself is undergoing rapid star formation. The star-forming regions are the sites where the most energetic particles, also known as cosmic rays, are produced. The interaction of cosmic rays with the surrounding

interstellar gas and radiation fields could produce the  $\gamma$ -ray emission observed from such objects. Therefore, the  $\gamma$ -ray radiation detected from “Kathryn’s Wheel” has been suggested to be produced by star-forming activities. The data taken by NASA’s Large Area Telescope instrument onboard the Fermi Gamma-ray Space Telescope was used to confirm the  $\gamma$ -ray detection of this enigmatic galaxy collision. Although located in our Galactic backyard, this object has been little studied because of the presence of a bright nearby star, HD 150915, and its location in a crowded, low-latitude area close to the Galactic plane, where identifying astrophysical sources is challenging due to extreme dust obscuration. “Kathryn’s Wheel” can be considered a test bed to explore the origin and transport of cosmic rays and their connection with star-forming activities, given its proximity to the Milky Way.

#### Reference:

“A Gamma-ray Emitting Collisional Ring Galaxy System in our Galactic Neighborhood” Vaidehi S. Paliya and D. J. Saikia. The Astrophysical Journal Letters, 967, L26, 2024 [DOI: <https://doi.org/10.3847/2041-8213/ad4999>]



**Dr. Vaidehi S. Paliya** is an assistant professor at IUCAA. He completed his doctoral research on high-energy emission from active galactic nuclei [AGN] from the Indian Institute of Astrophysics [IIA] under the joint supervision of Dr C. S. Stalin [IIA] and Dr C. D. Ravikumar [University of Calicut] in 2016. He then moved to Clemson University, USA, for his first postdoctoral position (2016–2018), where he also worked with the Fermi–Large Area Telescope collaboration. In November 2018, as a postdoctoral fellow, he joined the multi-messenger astronomy group at Deutsches Elektronen Synchrotron, DESY, Germany, and worked on the AGN jet–neutrino connection. Before joining IUCAA in April 2022, he worked as Scientist-C at the Aryabhata Research Institute of Observational Sciences [ARIES], Nainital, from December 2020 to March 2022. Dr. Paliya’s primary research focuses on understanding the relativistic jet phenomenon [launching, propagation, and termination] associated with AGN following a multi-wavelength approach and using observations from ground- and space-based telescopes.



## Of Galactic Spiral Arms and Traffic Jams

According to the Tuning Fork diagram, Hubble's morphological classification of galaxies is that galaxies are of two types: elliptical and disc galaxies. In the ellipticals, the stars are random motion-supported against gravitational collapse; in the discs, they are rotationally-supported. The spiral arms constitute the most spectacular features of disc galaxies and distinguish them from other astronomical objects. Observational studies indicate that the spiral arms rotate as a rigid pattern with a constant angular speed called the pattern speed. Spiral galaxies are ubiquitous, and more than 60 % of disc galaxies in the nearby universe are spirals.

**Spiral arms and galactic secular evolution:** The quadrupole moment inherent in the gravitational potential of non-axisymmetric disc dynamical features, such as the spiral arms, results in torques that induce angular momentum transfer between the disc and the dark matter halo. Spirals also trigger gas inflow from the outer galaxy, which feeds the active galactic nuclei. Furthermore, being the overdense regions in the galactic disc, they favor the compression of gas clouds and therefore are the primary sites of galactic star formation. Therefore, the spiral arms play a fundamental role in the secular evolution of galaxies.

**The winding dilemma:** Until the middle of the last millennium, the mechanism of the formation and sustenance of spiral structures in the galactic discs was an enigma. It was well-known that galaxies rotated between 20 to 100 times since the formation of their host galaxies. This meant that if the spiral arms were material arms, i.e., composed of the same stars and gas clouds, they would have wound up 20 to 100 times during this period. Such arms are called material arms, and the problem of wrapping them is known as the winding dilemma. However, observed galaxies do not have spiral arms wrapped up more than once or twice in the azimuthal direction.



*The Whirlpool Galaxy [Credit: NASA/ESA and The Hubble Heritage Team STScI/AURA]*

This implies that either spiral arms are short-lived or they are not material arms

**Traffic jams, galactic spiral arms, and density waves:** Let us try to understand how galactic spiral arms form from the following scenario: A procession slowly moving down the highway and triggering a traffic jam by creating a bottleneck. On approaching the procession, vehicles first slow down momentarily while passing by the procession, then slowly pick up speed, and finally continue on their way at their normal speed. Now let us study this

phenomenon from the vantage points of two observers: first on an airplane and the second on the service road. The first observer reports a region of high traffic density around the procession and sluggishly moving with it. Interestingly, the second observer notes that the jam never consists of the same vehicles for long periods of time; they are promptly replaced by other vehicles coming from behind. The traffic jam is, therefore, an example of a density wave, and so are the galactic spiral arms.



Just as a fixed set of vehicles does not constitute a traffic jam, the spiral arms are not associated with a specific group of stars or gas clouds. Akin to the traffic jam analog, disc stars and gas clouds enter the spiral arm and slow down for a while by falling into the potential well resulting from the enhanced disc density therein; they eventually climb out of the well and then continue on their orbits around the galactic center. Consequently, we have a moving region of high stellar and gas density involving different parts of the disk at points in time.

In both the case of the traffic jam and the galaxy, the wave moves slowly and independently of the overall flow of the medium. Further, the traffic jam can persist long after the procession has left the road; similarly, the spiral structure can persist long after the perturbing source has ceased to exist.

### Density waves & normal modes of oscillation

The essence of the density wave theory is to determine the functional form of the perturbed surface density, which allows the perturbation to be a normal mode of oscillation of the system. For such a mode, the disturbance in the gravitational field associated with the asymmetric distribution of matter equals the

perturbation field required to invoke the asymmetric response.

### Energy exchange between wave and matter

Due to the differential rotation of the disk, there occurs an exchange of angular momentum and energy between the disk and the spiral wave. It can be shown that this exchange primarily happens at the so-called Lindblad Resonances, where the frequency at which the star intersects the crests and troughs of the spiral wave potential is either zero [i.e., the star is always in phase with the potential] or equals the oscillation frequency of the star near the circular orbit. In fact, at the Outer Lindblad Resonance (OLR), energy is absorbed, and the wave gets reflected. On the other hand, at the Inner Lindblad Resonance (ILR), energy is emitted, and the wave gets damped.

### Stationary or Standing Waves in the radial direction

If a spiral wave is absorbed at the ILR, then the spiral structure will not be long-lived. However, if the wave gets reflected before it reaches the ILR, a wave pattern quasi-stationary in the radial direction can be established. Some physical features of the disk inhibit the wave from reaching the ILR [the Q-barrier] and thus favor the formation of standing wave patterns, also

called wave modes.

### Why are spiral structures mostly two-armed?

Higher-order resonances are dynamically less significant, also because they either lie outside the galaxies or very close to the galactic center. For a 3-armed spiral, for example, the resonances are near the co-rotation radius. Interestingly, however, the resonances are roughly separated by the galaxy's radial extent in the case of a 2-armed spiral. These possibly explain the ubiquity of two-armed spirals in the local universe.

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2. Galaxies & Galactic Structure: Elmegreen, Prentice Hall
3. Dynamics of Galaxies: Bertin, Cambridge University Press
4. Physics of Astrophysics II: Shu, University Science Books
5. Physics of Gravitating Systems II: Fridman & Polyachenko, Springer-Verlag.



**Dr. Arunima Banerjee** is a theoretical astrophysicist specialising in the dynamics of galaxies and the application of machine learning in galactic astronomy. She is currently an associate professor and the associate chair at the Department of Physics at the Indian Institute of Science Education and Research Tirupati and a Visiting Associate of IUCAA, Pune. She is also an Editorial Board Member of the Journal of Astronomy & Astrophysics of the Indian Academy of Sciences and the Chairperson of the Working Group for Gender Equity of the Astronomical Society of India. Music, painting, and reading are her favourite pastimes.



## Events at IUCAA

### GW Open Data Workshop (ODW) by the LIGO-Virgo-KAGRA collaboration



The IUCAA chapter of the “GW Open Data Workshop” was organised by the Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune, and took place over three days from April 18 - 20, 2024, at IUCAA, Pune. The workshop was an ongoing effort by the LIGO-India scientific collaboration members of IUCAA to provide local college and university participants in Pune with a detailed understanding of gravitational wave data analysis

techniques. This was the third consecutive year of organising a workshop in sync with the main Gravitational Wave Open Data Workshop organised by the LIGO-Virgo-KAGRA collaboration.

The participants attended online lectures on various topics on gravitational-wave science and were helped with the hands-on sessions on data analysis tutorials. The workshop attracted thirty undergraduate

and postgraduate participants from the physics and engineering branches. Over three days, participants engaged in in-depth sessions that enhanced their understanding of actual search and parameter estimation of gravitational wave events. The workshop was coordinated by Apratim Ganguly and Sanjit Mitra..

### Refresher Course on Astronomy and Astrophysics and the online Summer School on Astronomy and Astrophysics

The Refresher Course on Astronomy and Astrophysics 2024 was held at IUCAA from May 13 - June 14, 2024. It was held concurrently with the Online Summer School on Astronomy and Astrophysics. There were eighteen faculty participants from higher educational institutions located across the country.

The lectures covered a wide range of topics, introducing the basic and advanced

topics of the field, which included introductory astronomy, optical astronomy techniques, radio astronomy, radiative processes, stellar structure and evolution, the Sun, galaxies, interstellar medium, active galactic nuclei and jets, gamma-ray astronomy, compact objects, black holes, neutron stars and pulsars, gravitational lensing, high-energy astrophysics, fluids and plasmas, gravity, general theory of relativity and cosmology, structure formation.

The other interesting topics included gravitational wave astronomy and LIGO, artificial intelligence in astronomy, quantum clocks, and the mega projects in which IUCAA is involved, such as the Thirty Meter Telescope, LIGO, Aditya-L1 and Rubin LSST. There were hands-on sessions on practical statistics using Python, MUSE data analysis, PLUTO





Inter-University Centre for Astronomy and Astrophysics  
Astronomy Centre for Educators (ACE)  
Malaviya Mission Teacher Training Centre (MMTTC)

REFRESHER  
COURSE ON  
ASTRONOMY  
AND  
ASTROPHYSICS  
2024

Last date of registration: 15th March 2024  
Starting date of refresher course: 13th May 2024  
Ending date of refresher course: 14th June 2024

The refresher course on Astronomy and Astrophysics will be conducted by leading experts in the field covering some of the basic topics along with recent developments and the emerging areas in the field. This course is open to faculty members of higher-educational institutions only.

Participants will have to be present at IUCAA for the entire course duration. Certificates will be provided based on attendance, participation, and assessments. Travel support and free hospitality will be provided to all participants as per norms.

For registration follow the link: <http://bit.ly/rca2024>  
For any queries please contact: [nrciucan@gmail.com](mailto:nrciucan@gmail.com)

Credit: NASA, ESA and the Hubble Heritage (STScI/AURA)-ESA/Hubble Collaboration

numerical simulations, radio interferometric imaging, cosmological simulations, X-ray, UVIT and gravitational wave data analysis. The participants also had the opportunity to visit the different laboratories (instrumentation, precision quantum measurement, gravitational wave, astrophysics laboratory of ACE) and the science popularisation centre of IUCAA. The participants also went on a one-day trip to the Giant Metrewave Radio Telescope. The sessions were conducted by faculty members, scientific staff, postdoctoral fellows and research scholars of IUCAA. The Refresher Course was coordinated by Rajeshwari Dutta and Team ACE IUCAA.

## Events outside IUCAA

### Introductory Workshop on Astrophysics and Cosmology

The Introductory Workshop on Astrophysics and Cosmology, organised by the Department of Physics, Integral University, Lucknow, Uttar Pradesh, in collaboration with IUCAA, Pune, was held

from May 02 - 04, 2024. The workshop provided a platform for students to delve into the captivating realms of astrophysics and cosmology through lectures, discussions, and oral presentations. About

forty-five participants attended the workshop, with twenty-five coming from Lucknow and the remaining from nearby Indian states.





The resource persons for the workshop included T. R. Seshadri [University of Delhi], who delivered the lectures on Cosmology. Anand Sengupta [IIT, Gandhinagar] delivered lectures on Gravitational Waves. Sanil Unnikrishnan [St. Stephen's College, Delhi] delivered lectures on the General Theory of Relativity. Mohammad Sajjad

Athar [Aligarh Muslim University, Aligarh] delivered lectures on the Synthesis of the Elements in Stars.

On the first day, all the speakers delivered the introductory lectures and moved to an advanced level of their respective topics over the rest of the two days. A session was

devoted to the oral presentation of the students. The last session concluded with open questions, pursuing a career in Astrophysics & Cosmology and closing remarks. The workshop was coordinated by M. Shahalam [Integral University, Lucknow] and Aseem Paranjape [IUCAA, Pune].

## High-Performance Computing in Science





The IUCAA Centre for Astronomy Research and Development [ICARD], Department of Physics, University of Kashmir, in association with IUCAA, organised a three-day workshop on High-Performance Computing from May 22-24, 2024, at the University of Kashmir. Sixty participants, including M.Sc. [Science] students, Ph.D. students and faculty, attended the workshop. Resource persons from IUCAA,

namely, Aseem Paranjape, Dipanjan Mukherjee [online], Mayur Shende, Nishant Singh and Sanjit Mitra, kept the participants engaged with lectures that included information about the requisite knowledge and skill in handling an HPC. In addition to the lectures, the resource persons encouraged hands-on sessions and classroom interactions.

While a longer workshop duration would have helped, the three-day workshop provided the participants with a basic knowledge of using HPC for specific tasks appreciated by the participants, along with constructive feedback. The workshop was coordinated by Manzoor A. Malik [University of Kashmir] and Sanjit Mitra [IUCAA, Pune].

## Summer School in Theoretical (Astro) Physics



The Department of Physics and Electronics at St. Xavier's College [autonomous], Ahmedabad, in association with Kshama Ahmedabad Academy of Sciences, organised a six-day Summer School in Theoretical [Astro]Physics from June 03 - 08, 2024. The school's primary objective was to provide participants with a unique opportunity to expand their knowledge and engage with leading Astrophysics, Astronomy, and Cosmology experts. The workshop featured a mix of lectures and hands-on sessions delivered by six experts. Fifty participants attended the School.

The topics covered were General Relativity and Cosmology by Sachin Pandey

[University of Delhi], Machine Learning in Physics and Astronomy by Amit Reza [IWF, Graz, Austria], Plasma Physics for Astrophysics by Rajaraman Ganesh [IPR, Gandhinagar], Time-Dependent Problems in Quantum Mechanics\*\* by Anand Sengupta [IIT Gandhinagar], Atomic/Molecular Simulation Methods by Raghavan Ranganathan [IIT Gandhinagar], and Gravitational Wave Open Science Center\*\* by Gurudatt Gaur [St. Xavier's College, Ahmedabad] In addition to these sessions, a public lecture titled "Deciphering the Universe through Gravitational Waves" was delivered by Bala Iyer [ICTS-TIFR, Bengaluru].

A scientific visit to the Institute for Plasma

Research, Gandhinagar, was organised for the participants during the school. Furthermore, about twelve participants presented their research work in two dedicated sessions. The School also featured a cultural evening, which the participants enthusiastically attended. The participants received a certificate for completing the school. The School was coordinated by Gurudatt Gaur [St. Xavier's College, Ahmedabad] and Sanjit Mitra [IUCAA, Pune].

## Welcome to...

**Anindya Ganguly** who has joined IUCAA as a Research Associate-I under DST-SERB, and

**Sanket Ajay Munishwar** who has joined IUCAA as a Junior Research Fellow.

## Farewell to...

**Megha Anand, Srimanta Banerjee** and **Chayan Mondal**, Post-Doctoral Fellows, who left IUCAA at the end of their tenure or to take up a new assignment.

**Bhaskar Arya, Anuj Mishra** and **Aromal P.**, Senior Research Fellows, who left IUCAA at the end of their tenure.

## Colloquium

05.04.2024 M. S. Ranganathan on ***Some reminiscences relating to Harish-Chandra.***

17.05.2024 Shadab Alam on ***Unveiling the Enigma of Dark Energy through the DESI Galaxy Survey.***

## Seminars

12.04.2024 Karthik Rajeev on ***Multiphoton scattering amplitudes in external backgrounds.***

16.04.2024 Bhavana Bhat on ***Dynamical evolution of Galactic Globular clusters: Insights from new diagnostics.***

18.04.2024 Bhooshan Gadre on ***Hunting for sub-solar mass compact objects in binaries binary mergers using GWs.***

29.04.2024 Suddhasattwa Brahma on ***Quantum origins of the universe: Cosmological open quantum systems.***

30.04.2024 Sudip Mandal on ***Understanding the dynamic nature of the solar atmosphere.***

20.05.2024 Mudit Srivastava on ***Multi-wavelength Exploration of Symbiotic Binaries and Novae through Diverse Instrumentation.***

06.06.2024 Sumit Kumar on ***Probing large-scale structures of the Universe with GWs and optimal strategies for combining GW+EM data.***

27.06.2024 Arunima Banerjee on ***How does a low surface brightness galaxy form spiral arms?***



# Astronomy Centre for Educators

## Objective: Professionalize astronomy education

The IAU OAE office called for teacher training proposals [TTP] from teachers and astronomers worldwide. Proposals were received from several countries, and the

OAE Center India was part of the review team. The results of the TTP grants will be announced shortly. The OAE Center India is also collaborating with SciPop to organise

a few teacher training programs with teachers from Pune and the surrounding regions in the next few months.

## Objective: Provide access to good resources

### • Resource Translations

The Big Ideas book has been translated into Marathi by OAE Center India. The translation of the book is under review and will soon be live. The Indian team has also helped to move the Farsi and traditional Chinese translations of the Big Ideas book into the InDesign form suitable for printing.

### • New Resources

The OAE Center India is involved in making astronomy glossary cards containing the IAU astronomy glossary and related images. The cards were recently modified to adhere to the licenses of the images being used. The

Center has started the initial process of printing these cards, which they plan to distribute to school libraries as educational resources along with astronomy books in the coming months.

## Objective: Promote astronomy in curricula

The OAE Center India finished the project of the baseline survey in Astronomy, where the status of astronomy education among

school students was analysed. The paper has been submitted recently. The second part of the project, which deals with

teachers' perceptions of astronomy education in schools, is ongoing.

# Public Outreach Activities

## Astronomy Workshop



An astronomy workshop was held at IUCAA on April 27, 2024, for the students of the G H Raisoni College of Engineering and Management, Wagholi. Fifty students attended the workshop.



## Science Toys Workshop



April 08, 2024: D. G. Walse Patil, New English School, Pargaon, Pune, 68 students participated in the workshop.



June 13, 2024: Saraswati Vishwa Vidyalaya National School, Talawade, Nigdi, 60 students participated in the workshop.



## Summer Astronomy Camp

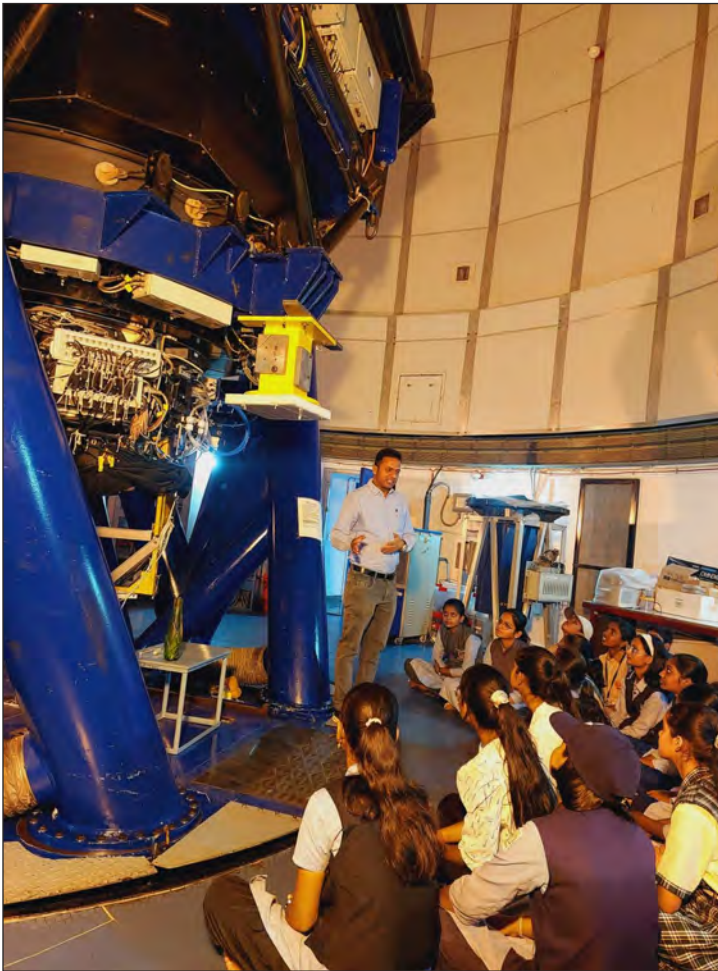


Summer Astronomy Camps were conducted at IUCAA in three batches during the dates listed below:

- April 29 - May 03, 2024
- May 06 - 10, 2024
- May 14 - 16, 2024 [Rural]









## Telescope Making Workshop

**April 15, 2024:** A telescope-making workshop conducted at the Ashoka Universal School and Junior College, Nasik. Twenty students participated in the workshop.



**April 27-28, 2024:** A telescope-making workshop conducted at St. Xavier's School, Sardhana, Meerut District, Uttar Pradesh. Fifty students participated in the workshop.



One-day telescope making workshop conducted at IUCAA, Pune, on 24th May 2024. Seven refracting telescopes were made by the participants.





Radio Telescope Making and Hands-on Science Workshop, Ashoka University, Sonapat during 03-08 June 2024.



# Astronomy Centre for Educators

## Malaviya Mission Teacher Training Centre

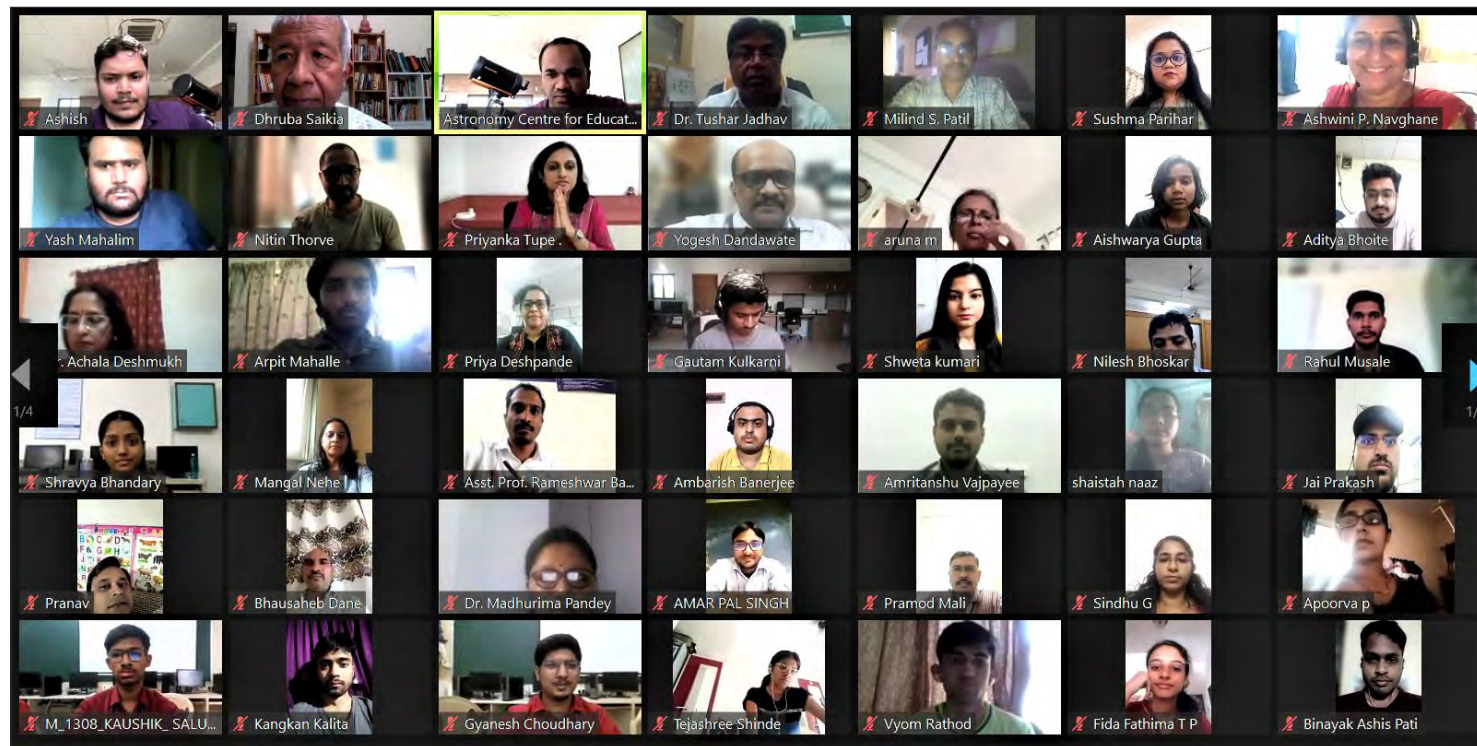
### Advances in Astronomy: Integrating Technology in Astronomy Research

A short-term online workshop titled Advances in Astronomy: Integrating Technology in Astronomy Research was held from April 01 - 05, 2024, in collaboration with the Vishwakarma Institute of Information Technology, Pune. The objectives were to explore the fundamentals of astronomy and applications of engineering/ technology in astronomy research; introduce participants to astronomical data acquisition, processing, and analysis techniques; provide hands-on sessions in Instrumentation, signal and image processing methods relevant to astronomical data; examine the integration of cutting-edge technologies such as instrumentation, data science, machine learning, and artificial intelligence in astronomy research; enable participants to develop innovative approaches for

utilising astronomy data in multi-disciplinary research projects; foster collaboration and knowledge exchange among faculty members from diverse disciplines; and empower faculty members to incorporate astronomy concepts and techniques into their teaching curriculum, promoting interdisciplinary education and research.

Faculty members, scientific staff, post-doctoral fellows and research scholars from IUCAA, the National Centre for Radio Astrophysics and the Pune Knowledge Cluster took part in delivering lectures and conducting hands-on sessions. About eighty participants attended regularly and performed satisfactorily in the evaluation. The workshop was coordinated by Tushar R. Jadhav, Milind S. Patil, Mandar S. Karyakarte, Gajanan H. Chavhan from

Vishwakarma Institute of Information Technology and Team Astronomy Centre of Educators [ACE], IUCAA.





# Online STTP on Advances in Astronomy : Integrating Technology in Astronomy Research



Online one week

## Short Term Training Program on

### "Advances in Astronomy : Integrating Technology in Astronomy Research"

1<sup>st</sup> April to 5<sup>th</sup> April 2024

in association with

Astronomy Centre for Educators,  
IUCAA, Pune

Organized By

DEPARTMENT OF ELECTRONICS &  
TELECOMMUNICATION ENGINEERING

Antariksh Club, VIIT Pune  
(Celebrating 15 years of Antariksh Club)

Bansilal Ramnath Agarwal Charitable Trust's

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Survey No. 3/4 Kondhwa (Budruk), Pune 411 048, INDIA.  
Website: www.viit.ac.in

## OBJECTIVES

- ❖ Explore the fundamentals of astronomy and application of engineering/ technology in astronomy research.
- ❖ Introduce participants to astronomical data acquisition, processing, and analysis techniques.
- ❖ Provide hands-on sessions in Instrumentation, signal and image processing methods relevant to astronomy data.
- ❖ Examine the integration of cutting-edge technologies such as Instrumentation, data science, machine learning, and artificial intelligence in astronomy research.
- ❖ Enable participants to develop innovative approaches for utilizing astronomy data in multi-disciplinary research projects.
- ❖ Foster collaboration and knowledge exchange among faculty members from diverse disciplines.
- ❖ Empower faculty members to incorporate astronomy concepts and techniques into their teaching curriculum, promoting interdisciplinary education and research.

## About IUCAA

The Astronomy Centre for Educators (ACE) was established at IUCAA, originally under the Pandit Madan Mohan Malviya National Mission on Teachers and Teaching scheme of the Ministry of Education, Government of India. The centre aims to establish courses in Astronomy and Astrophysics at colleges and universities throughout the country, work towards capacity building in the subject in theoretical and experimental areas, and train and support present and future teachers of the subject. IUCAA The Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune (an autonomous institution set up by the University Grants Commission), is a leading centre of research in a wide range of areas in Astronomy and Astrophysics. Astrophysicist Prof. Jayant Narlikar, along with Prof. Ajit Kembhavi and Prof. Naresh Dadhich set up IUCAA within the Pune University campus in 1988. IUCAA aims to be a centre of excellence within the university sector for teaching, research and development in Astronomy and Astrophysics. IUCAA was set up with the basic purpose of providing advanced centralized facilities for subjects not adequately covered in the university departments.

## Well-known Researchers from IUCAA, NCRA, GMRT, TIFR and other Research Institutes



Prof. Dhruva J. Saikia  
IUCAA



Prof. Ajit Kembhavi  
IUCAA



Prof. A. N. Ramaprakash  
IUCAA



Prof. Yogesh Wadadekar  
NCRA-TIFR



Prof. Sanjit Mitra  
IUCAA



Prof. Durgesh Tripathi  
IUCAA

## About VIIT, Pune

Established in 2002, Vishwakarma Institute of Information Technology (VIIT) is committed to providing excellent technical education and holistic development to aspiring engineers. In 2017, it became autonomous with permanent affiliation to Savitribai Phule Pune University. Over the last years, VIIT has shown remarkable growth with 11 undergraduate, 05 postgraduate, and 04 doctoral engineering programs, along with ISO certifications, NBA and NAAC accreditations, and top rankings. The institute follows outcome-based education, offering student-centric teaching and fostering independent thinking. Industry connections, strong faculty, and research focus ensure students are well-prepared for jobs, higher studies, and entrepreneurship. VIIT prioritizes students' holistic development through various support systems, including NSS, WEC, EDC, Robocon, Avishkar Cultural Club, and more, while continually striving for quality improvement with stakeholder improvement.



**VISHWAKARMA INSTITUTE OF INFORMATION TECHNOLOGY, Pune 48**

A section of the participants and the poster announcement

## Astronomy, Science and Society

A workshop on the theme of Astronomy, Science and Society was organised on April 19 - 20, 2024, at The New College, Kolhapur, by the Maharashtra State Faculty Development Academy [MSFDA] and the Astronomy Centre for Educators of IUCAA. The objectives of these workshops, which are often held in smaller towns of Maharashtra, are to bring the excitement of astronomy and science to faculty members across disciplines and also discuss broader issues related to science and society, such as inclusiveness and non-discrimination. During this workshop, Pushpa Khare gave an overall survey of the constituents of the Universe and also spoke on gravitational waves, Prakash Arumugasamy described the scales of the

Universe, Dhruva J. Saikia gave a glimpse of the major astrophysical questions and discussed higher education, astronomy, science and society, Jameer Manur introduced them to the night sky, while Prakash Arumugasamy and Jameer Manur also conducted a hands-on session. There was also a bird-watching session at Rankala Lake on the morning of April 20, where over about thirty-five species were sighted. The participants enthusiastically took part in all the events. The workshop had about forty participants, including resource persons and organisers. The workshop was organised by Apurva Barve, Kalyani Gokhale, and Kabeer Palshikar from MSFDA, as well as Team ACE, IUCAA.

MSFDA, ACE of IUCAA, and The New College, Kolhapur are pleased to invite you to participate in a workshop on the theme:

### ASTRONOMY, SCIENCE AND SOCIETY

Venue:  
The New College, Shivaji Path, Kolhapur  
(the registration form has the detailed address)

Dates:  
April 19-20, 2024  
(limited accommodation for outstation participants)

The sessions will consist of lectures, discussions, demonstrations and activities to highlight the richness and diversity of our Universe, recent advances, leading astronomical facilities in India and globally, and the scientific method. It will attempt to stress the importance of embracing diversity in all its forms, inclusiveness and rational thinking.

The workshop is open to faculty members and students of any discipline from colleges, universities, and other higher educational institutions of Maharashtra, with preference to those in the Kolhapur division. The presentations and discussions will be non-mathematical and at a semi-popular level.

Registration fees of Rs. 1000/- only (non refundable) to be paid to MSFDA will cover accommodation and food. Payment link will be shared with the selected participants.

Last date for registration: April 10, 2024  
Link for registration form: <https://shorturl.at/cAQY3>  
QR for registration form:

Contacts:  
Ajay Padvi | Email: [ajay.msfda@gmail.com](mailto:ajay.msfda@gmail.com), Mobile: 7262079089  
Dhruva J. Saikia, IUCAA | Email: [nrciucac@gmail.com](mailto:nrciucac@gmail.com)

Image Credit: NASA, ESA and the Hubble Heritage Team STS/AURA/ESA/Hubble Collaboration






A group photograph of the participants with the Principal of The New College and the poster announcing the programme at The New College, Kolhapur

## National Education Policy (NEP) Orientation and Sensitization Programmes

An NEP Orientation and Sensitization Programme under the Malaviya Mission Teacher Training Programme was held online from May 01 - 05, 2024. For this programme, the resource persons were Saikat Majumdar, Ashoka University, on holistic and multi-disciplinary education; Ved Prakash, former Chairperson, University Grants Commission and Priya Jadhav, IIT Bombay on higher education and society; Furqan Qamar, Former Secretary General, Association of Indian Universities, and Dhruva J Saikia, IUCAA on academic leadership, governance and management; Vineeta Sirohi, NIEPA, and Narayan Sharma, Cotton University, on skill development; Jayashree Shinde, SNDT Women's University, and Prakash Arumugasamy, IUCAA, on information and communication technology; Shekhar C Mande, NCCS and former Director General, CSIR, on research and development; Deepa Chari, HBCSE, TIFR, and Nandini Chatterjee Singh, UNESCO-MGIEP and NBRC, on student diversity and inclusive education; and Sharada Srinivasan, NIAS, on Indian knowledge systems. About 200 participants attended the programme.



**MALAVIYA MISSION**  
TEACHER  
TRAINING PROGRAMME

**Malaviya Mission Centre**  
Astronomy Centre for Educators  
Inter-University Centre for Astronomy and Astrophysics



N  
E  
P

A two-week, online capacity-building programme on

**National Education Policy  
Orientation & Sensitization**

for faculty members, research scholars, research associates, post-doctoral fellows, demonstrators, and tutors, in all higher-educational institutions

**NEP Orientation & Sensitization themes:**

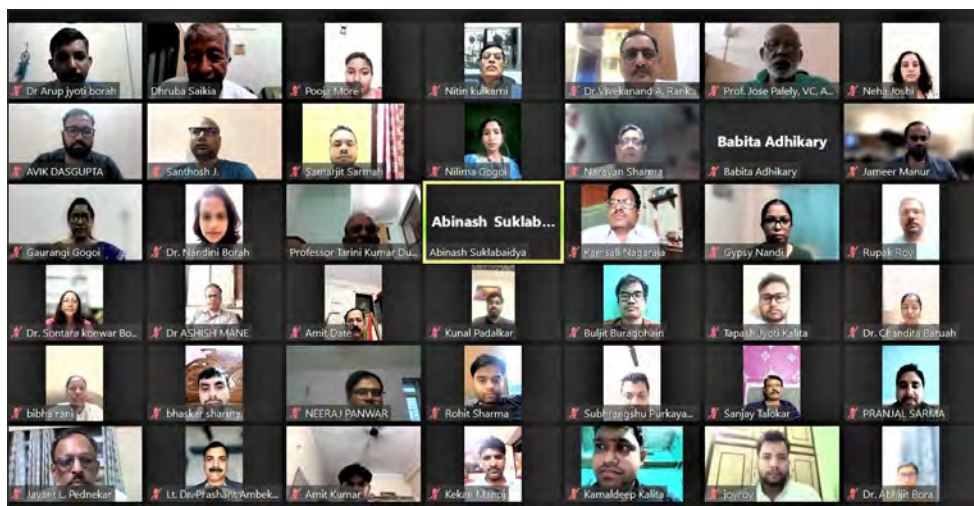
- ✓ Holistic and Multidisciplinary Education
- ✓ Indian Knowledge Systems
- ✓ Academic Leadership, Governance, and Management
- ✓ Higher Education and Society
- ✓ Research and Development
- ✓ Skill Development
- ✓ Student Diversity and Inclusive Education
- ✓ Information and Communication Technology

The schedule comprises two 90-minute presentations on each theme conducted over eight days, followed by an online assessment. Faculty members will receive an online certificate on successful completion of the programme.

**Join the May 2024 Session:**  
1st - 15th May, 2024  
Last date of registration:  
30th April, 2024

General information on the programme:  
<https://mmc.ucaa.ac.in/>  
Registration: <https://mmc.ucaa.ac.in/registration/index>  
Registration guide: [https://bit.ly/mmttp\\_guide](https://bit.ly/mmttp_guide)  
Select IUCAA as center during registration for the course

There is no registration fee required for the programme  
For any queries: [nrciucaa@gmail.com](mailto:nrciucaa@gmail.com)



A screenshot of a section of the participants and the poster announcement

## Visitors

[April- June 2024]

Abisa Sinha Adhikary, Gazi Ameen Ahmed, Shadab Alam, Sonej Alam, Musavvir Ali, G. Ambika, H.M. Antia, Anver Aziz, Joydeep Bagchi, Shamanna Balasubramanya, Arunima Banerjee, Rameshwar Shivaji Bankar, Bhavana Bhat, Naseer Iqbal Bhat, Debbijoy Bhattacharya, Sree Bhattacharjee, Sujay Kr. Biswas, Sajad Ahmad Boked, Suddhasattwa Brahma, Dwij Brahmabhatt, Mridusmita Buragohain, Dipali Sadashiv Burud, Fairros C., Madhukrishna Chakraborty, Subenoy Chakraborty, Nand Kumar Chakradhari, Hum Chand, Anirban Chanda, Suresh Chandra, Philip Charles, Asis Kumar Chattopadhyay, Suchismito Chattopadhyay, Pranjal Chaturvedi, Shivani Chaudhary, Vishal Chaudhary, Laxmikant Chaware, Phanindra D.V.S., Mamta Dahiya, Pravat Dangal, Bibhash Das, Satyapriya Das, Mami Deka, Sanmesh Manish Deshmukh, Avinash Deshpande, Reshma Dessai, Moon Moon Devi, Parmeshwar Dewangan, Sagar Dey, Ruchika Dhaka, Praveen Kumar Dhankar, Payaswinee Dhoke, P.P. Divakaran, Vijayakumar Honnappa Doddamani, Lokesh Kumar Duchaniya, Broja Gopal Dutta, Bhooshan Gadre, Mayukh Raj Gangopadhyay, Sudip Kumar Garain, Sakshi Gautam, Srotoshi Ghosh, Sumit Ghosh, Surajit Ghosh, Keshav Godami, Rupjyoti Gogoi, G.K. Goswami, Shreyan Goswami, Sarbari Guha, Ranjan Gupta, Sourendu Gupta, Priya Hasan, Syed Najamul Hasan, Nazma Husain, Md. Sayeedul Islam, Joe Jacob, Sudeep Singh Jain, Venu Jangam, Akhila K., Jeena K., Siddheshwar Kadam, Naga Satyanarayana Kalidindi, Sammi Kamal, Shashi Kanbur, Akashdeep Karan, Pema Khandu, Ram Kishor, Nagendra Kumar,

R.K. Sunil Kumar, Rajesh Kumar, Sanjay Kumar, Sumit Kumar, Kerdaris Kurbah, Parvinder Maini, Sangita Maiti, Prajwal Majumder, Manzoor A. Malik, Siddharth Malu, Goutam Mandal, Soma Mandal, Sudip Mandal, Rita Mate, Parita Mehta, Irom Ablu Meitei, Kyle Francis Miller, Bivudutta Mishra, Swagat Mishra, Aditya Sow Mondal, Soumen Mondal, Sreejith Nair, Hemwati Nandan, Varun Nikam, Devendra Ojha, Haris P., Ramesh. P., Prince P.R., Sreebala P.S., Sreejith Padinhatteeri, Mayukh Pahari, Main Pal, Kunj Panchal, Sanjay Pandey, Mahadev Pandge, Uma Papnoi, Rekha Patel, K.D. Patil, Pravin Patole, B.C. Paul, Geetha Paul, Ninan Sajeeth Philip, Anirudh Pradhan, Arbind Pradhan, Sasmita Kumari Pradhan, Chetan Prakash, Raj Prince, Anagha R., Madabusi Raghunathan, Govind Swaroop Rahangdale, Karthik Rajeev, Gitanjali Erassery Rajulal, Shantanu Rastogi, B.S. Ratanpal, Shankar Ray, Biplab Raychaudhuri, Atish Roy, Soumya Kanti Roy, Nagabhushana S., Subhajit Saha, Parbati Sahoo, Anish Sarkar, Somasri Sen, T.R. Seshadri, Shiv Sethi, Vipin Kumar Sharma, Dhvani Sheth, Ravi Kiran Sheth, Juie Shetye, Luc Simard, Deobrat Singh, Gyan Prakash Singh, Kedar Singh, Pratyush Singh, Ramanshu Prabhakar Singh, Saikhom Johnson Singh, T.P. Singh, Kanchan Soni, Ajay Sood, Tarun Souradeep, P. Sreekumar, S. Sridhar, Mudit Srivastava, Sree Suswara, Hitesh Tanenia, Vivek Baruah Thapa, Vedshree A. Theurkar, Aparajit Tripathi, S.K. Tripathy, Charis Tsakonas, Lajish V.L., Priyanka Vyas, Alan Weinstein, Nitin Yadav.

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



We welcome your feedback at the following address:

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