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Editor : Dipanjan Mukherjee (dipanjan@iucaa.in)

Editorial Assistant : Hemant Kumar Sahu (hksahu@iucaa.in)

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Tributes to
Professor Naresh Dadhich
[Life: September 01, 1944
- November 06, 2025]



R. Srianand

**Director,
IUCAA**

Prof. Naresh Dadhich passed away on November 6, 2025, in Beijing, China. He was on an academic visit to the Beijing Institute of Mathematical Sciences and Applications (BIMSA). This news comes as a shock to all of us who have known him to be extremely active in both his academic and personal life. His passing is a great loss to the global GR community. At IUCAA, we have now lost two of our founders within a span of six months.

When we begin our research careers, we all hope for good health and a sustained passion for research until our last breath. In some sense, this wish was fulfilled for Naresh. Even at the age of 81, he was regularly coming to the institute and remained deeply engaged in research with the same enthusiasm as a newcomer. He was on an academic visit, delivering lectures, right up to his final moments.

I will always remember Naresh as a simple, caring, and approachable person—someone easy to meet, interact with, and always relaxed, positive, and supportive of good ideas. With this calm and unhurried approach, he managed to accomplish many things, despite not being the most organised person.

Naresh became the Director of IUCAA on July 19, 2003, after the retirement of Prof. Narlikar. It was indeed a big responsibility to take on. In his retirement address, Prof. Narlikar mentioned two major challenges that he had been unable to resolve during his tenure. In his very first staff meeting, Naresh said that he would consider his tenure successful only if he could address

these two issues. All of us involved knew how difficult they were. Yet, through his persistent efforts, he managed to resolve both challenges satisfactorily within the first three years of his tenure.

This was possible because he never hesitated to take risks and was willing to meet people from all walks—within India and abroad—to get things done. Under his leadership, IUCAA became part of the SALT consortium and acquired observing shares, thanks largely to his contacts, guidance, and sustained support. To this day, it remains the only astronomy project in which an Indian institute holds observing shares in a telescope operated by an international collaboration. He was deeply committed to making IUCAA a place where science is discussed openly and freely. During his tenure, he started the “Neem Seminar,” an informal chalk-and-board seminar held under the Neem tree near the guest house reception. Overall, his tenure as Director was one of the most productive periods for IUCAA. He often used to say that being the Director of IUCAA is very easy—you just need to delegate responsibilities and support people so that they can deliver what they are supposed to do. I fully agree with him on this. We had very little overlap in our research interests. However, he was always enthusiastic about our projects related to the variation of fundamental constants. During a particularly difficult period for me and my students—when other groups were challenging our work in various international conferences—he was extremely supportive and genuinely curious to understand the bottom line. We often had long discussions on this topic, as well as on issues related to compact stars and black holes. He frequently came up

with out-of-the-box [or perhaps even “crazy”] ideas and would ask whether there was any way to test them observationally. In this sense, he belonged to a rare class of scientists who engage in research for the sheer joy of exploration and are willing to consider all possibilities. Such people are becoming increasingly rare these days. Having started his career in the university system, he was very keen that IUCAA members remain closely engaged with universities. He even suggested that all faculty should spend at least two weeks every year working in a university. To support this, he proposed that IUCAA could also support their partners if they accompanied them [something that would be nearly impossible to implement today!]. He had built strong personal rapport with IUCAA Associates and their students across the country. Until recently, he continued visiting various universities and colleges to deliver lectures and teach courses. He also maintained very strong ties with researchers in South Africa. In many ways, his personal contacts enabled IUCAA members to be part of major international surveys such as the “MeerKAT Absorption Line Survey [MALS]”, “Looking at the Distant Universe with the MeerKAT Array [LADUMA]”, and the “Hydrogen Intensity and Real-time Analysis eXperiment [HIRAX]”. Naresh was extremely kind to his colleagues. I personally benefited from his generosity during certain moments when I needed help, as well as during our trips abroad together. While I am not sharing those details here, I will always cherish those memories. We at IUCAA and I personally will miss his guidance and support during this crucial period.

Ajit Kembhavi

**Former-Director,
IUCAA (2009 - 2015)**

Much has already been written about Professor Naresh Dadhich in many articles and stories about him which appeared after he passed away last November, and there are many articles in this issue of Khagol covering various aspects of work, contributions and personality. In this brief contribution, I will focus on his amazing ability to network with people, develop long term relationships and collaborations, and



to convey the excitement of research to every level of the academic world.

Naresh's ability to develop relationships proved to be useful in the years following IUCAA's creation in the late 1980s, when information about IUCAA had to be taken far and wide in the country. Naresh travelled incessantly, sometimes accompanied by Jayant Narlikar and me and other colleagues, to the main cities, as well as to universities and colleges in the smaller cities and towns in far flung areas. He talked to the faculty and students there about the facilities that IUCAA offered. He convinced them that their specialisations in physics, mathematics and statistics could find wonderful applications in gravitation theory and astronomy. Their expertise could be harnessed to solving the many new problems emerging from the multitude of new techniques, telescopes and satellites, and the use of emerging information technology. Soon the tide turned, and more and more people started visiting IUCAA regularly to collaborate with the people there. New groups of astronomers emerged in several universities and colleges, and now we have a large thriving community contributing to the national astronomical effort. We were particularly successful in West Bengal, Assam, other North-Eastern states, Kashmir and Kerala, where there are a large number of talented young people looking for new opportunities. Naresh and I continued to travel to various centres until he left for China last October, never to return. We did that together for 36 years, acquiring in the process many collaborators and friends. Our younger colleagues now continue the tradition, bringing to IUCAA increasing numbers of



highly creative modern young people.

Naresh had deep and abiding friendships and collaborations with a number of relativists and astrophysicists in many countries. There was an unusual element to these collaborations. While he worked with leading scientists in Western countries, as many of us do, and visited them often, he also collaborated over decades with groups in various countries like Uzbekistan and other Central Asian republics, Iran, Turkey, Pakistan and South Africa. Faculty as well as students from these countries visited IUCAA regularly, and many Ph.D. theses were produced through these interactions. His ties with South Africa began soon after apartheid ended and during his many visits to the country, he developed close ties with the intellectual elite there, including scientists from different fields, artists, constitutional court justices, senior science administrators, vice-chancellors and others, and he even had a meeting with Nelson Mandela soon after his release from prison.

Naresh had very simple sounding explanations for profound and difficult to understand concepts like the universality of space and time, constancy of the velocity of light, the curvature of space-time and its manifestation as gravity, derivations of Einstein's field equations and so forth. He lectured on these matters to diverse audiences, ranging from professional scientists to students barely out of school, with the same words and elan. In the few months before Naresh passes away, I have heard him speak on these topics to early college students in Darjeeling and Masters and research students in Silchar. It was never clear to me how much of these lectures were actually understood by the young people listening to him, but they certainly enjoyed the experience of listening to a person who looked exactly like a scientist should, and spoke from his heart, wholly believing everything that he said.

Somak Raychaudhury

**Former-Director,
IUCAA (2015-2022)**

**Vice-Chancellor
and Professor of Physics,
Ashoka University, Sonapat**

I got to know Naresh well from when I joined IUCAA in 1995. It was clear from the beginning that he was the one who had worked closely with Jayant Narlikar to build this amazing institute. From day one of the project, from sitting down with architect Charles Correa for planning its design, digging the first hole on an empty plot to seeing the entire institution come to life, Naresh was a key person who helped shape





IUCAA in every possible way, and IUCAA had become his life's work.

One of my earliest memories at IUCAA was when Naresh took a few of us on an incredible journey to witness the total solar eclipse of 1995, which was visible from the Churu district of Rajasthan, where he had grown up. In his native village, under the stars on the night of Diwali, waiting for the Eclipse to come at dawn, surrounded by the people he had grown up with, we saw Naresh in his elements, from where he had started his incredible journey. At IUCAA, at the blackboard, with students and visitors, he was a different Naresh, earnest and passionate about science. His organisation of the international General Relativity conference GR-15 at IUCAA would be an unforgettable experience for many.

Equally memorable for me was how, through his connections with personalities in the world of art and performance, he would bring together events at IUCAA which we would otherwise never witness. The all-india one-act stage festivals featuring Habib Tanvir, Ratan Thiyam and Shaoli Mitra, and the classical vocal concerts in the kund and in the auditorium were comparable to the academic interactions we had with the stream of academic celebrities we had passing through IUCAA. One of his remarkable contributions was convincing Arvind Gupta to bring his energy and expertise to the science communication activities at IUCAA.

During my tenure as Director of IUCAA, it was such a pleasure to see Naresh every day at the institute, ever smiling, and inspiring us with the quiet and persuasive pursuit of his principles. JVN and he built

IUCAA brick by brick, and we hope we are worthy of his legacy.

Tarun Souradeep

**Director & Professor,
Raman Research Institute, Bengaluru**

I write with a heavy heart after a year in which India, in particular the gravitation and cosmology community, and IUCAA, lost two towering figures. Personally, it has been the loss of two warm-hearted mentor figures: Professor Jayant Narlikar and Professor Naresh Dadhich. From the day I first met them, at the age of 21, I never remember them making me feel the weight of the enormous chasm that separated us; this was then, and even now.

I will emphasize empowering the university sector, where Jayant and Naresh worked together. IUCAA would stand as a lasting legacy of their decades-long commitment to empowering the vast university sector. The two, in many ways, represent the basic idea of IUCAA – a celebrated scientist from a prestigious global institution and an established pedigree coming together with

a gifted Indian researcher who started from a small village in Rajasthan.

I was brought up in Delhi, studied at a premier undergraduate institution, and, due to a quirk of circumstances, landed up at IUCAA. At IITK, I first encountered the novelty of exceptionally talented, extraordinarily gifted peers who had come through challenging, unforgiving circumstances -- a reality of the broader Indian population beyond my experience, with obviously high raw intellect, rough edges of ignorance, and impropriety that get sandpapered off in urban places. In retrospect, I now note that they formed my core friends circle and always wondered, what if? Over the years, my conviction has been that this highlights the vast untapped talent pool in India that can and needs to be harnessed through concerted efforts by all research institutions to reach out to university talent. Naresh typified this conviction through his celebrated journey in science. Of course, when I met him, Naresh had already been through his struggles, but certain traits that many must have noted in their reminiscences are perhaps remnants of the refreshing candidness and disarming openness I recall among my close friends in my undergraduate circle. Very recently, I was reminded of this again when a former batch mate of mine, now a Secretary of some department, called out my nickname at a formal get-together in Delhi. I do treasure the fact that Naresh was always open and vocal about what he thought about me, my views, and actions. I may have continued on the wrong side many times, but never in doubt about what he thought.

The sharp contrast of his freewheeling course on General Relativity and



Gravitation in graduate school at IUCAA, to the 'proper' course I had taken as an undergraduate, in retrospect, does bring out why he is credited with very original ideas. So does his ability to air ideas in nebulous, nascent form that may be sound heresy to more domesticated academics. I did not have an opportunity to work on research with him. Still, I had the benefit of closely watching him run his research group and the positivity and encouragement he showed his students and other colleagues.

On a lighter note, I would like to narrate the story of my first meeting with Naresh.

I joined IUCAA, and there I first met Naresh at Pune Station in the wee hours of September 2nd, 1989. He had come to pick up scientists who had travelled to lecture at the first school of Gravitation and Cosmology organised by IUCAA. Coincidentally, I was in the waiting room too, having arrived by a train from Delhi that was 16 hours late. Characteristically, Naresh's first line could be construed as somewhat unwelcoming: "Ah! So you are actually joining IUCAA? We thought you were not joining." He did not bother to clarify that he was pleased, and it was only as I got to know him better that I felt sure he had meant to say so.

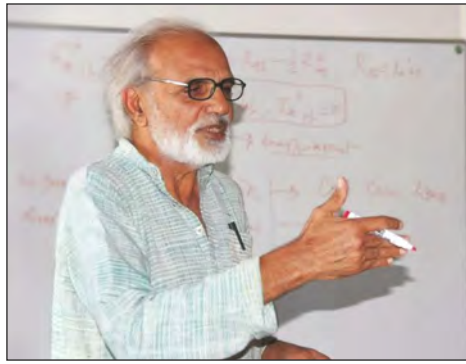
Naresh then took me on the ride of my life!!! He had marshalled a fancy red car, a Contessa, from CDAC, and drove me to Pune University, then charged into the women's hostel to pick up his student, Sucheta. We rode through the fantastic drive to the NDA campus and then to IAT. Little did I know then that Naresh had initiated something that would keep him in my thoughts throughout my life.

In summary, Naresh Dadhich was one of the numerous gemstones that must be strewn across the soil of India, has found its way to be recognised, polished, and will shine in the halls of the Indian academia.

Shyam Narayan Tandon

**Former faculty member,
IUCAA**

I remember that soon after taking over as the director he took deep interest in resolving two important issues which were



not fully resolved during Jayant's tenure. One of these was the commissioning of the 2-m telescope which was halted due to extra funds asked for by the company and he saw through its successful completion. The second issue was of the pension for IUCAA-staff and which had been pending for more than a decade. He got this resolved. In many situations, to solve the problem he used to take an approach involving direct conversation with the persons involved rather than thinking about any solution relying on the rules etc. I remember an instance when the difference of opinion between two senior colleagues, on an issue relating to the housing colony, was threatening to turn ugly. He just asked me to talk to these colleagues and let them cool down in the interest of our institute. My conversation with them did help.

We shall always remember him with gratitude."

Sanjeev Dhurandhar

**Former faculty member,
IUCAA**

Prof. Naresh Dadhich passed away at the age of 81 years – a nasty shock to everyone who knew him. Generally, he looked very fit,

full of energy and enthusiasm. This was his usual disposition. To me, his demise was devastating.

In this tribute, I will confine myself to my own personal experiences. I am sure that other colleagues and associates will do justice to other dimensions of his personality.

As a teacher, I knew Naresh from 1973, perhaps the longest among most, as a teacher in my master's class at the Mathematics Dept. of Pune University. I had opted for applied mathematics, which was essentially theoretical physics, and which was taught in the second year of M. Sc. During the classes, I used to ask questions and discuss a lot with him. He never discouraged me from asking questions and was himself enthusiastic about discussing [unlike some other teachers who actively discouraged students from asking questions or even got angry!]. My classmates, however, were most frustrated with him [and me for asking questions] and hated him because he was generally disorganised in his lectures and never gave any notes. But this was unimportant to me, because there were such excellent books available, Goldstein, for example, for classical mechanics, lucid books on relativity, etc., where was the need for notes? His lectures went beyond the regular curriculum; he had vision, and this reflected in his lectures. All other teachers taught from the given syllabus and gave the impression that whatever was in the syllabus and the books was all there was to it – Newton, Gauss, Maxwell, Einstein, etc., had done it all, and there remained nothing more to be done. At least, I got that impression, which was downright discouraging and made the subject uninteresting and irrelevant. This





was absolutely the wrong and non-motivating message to convey to young students. But in school, I was very keen on science and wanted to be a scientist like Jayant Narlikar [he was my hero and role model at the time]. But in the education that followed, I changed my mind and did not wish to do science in future and certainly not take it up as a career. I considered music and cricket as alternative possibilities. In sharp contrast, with Naresh, his lectures conveyed that all was not over with science - there was new and exciting science to be done and more importantly, done by *us* - it was not the end - the ball was in our court. It was then that I thought of taking up science as a career, after all. It was a 180-degree turn. I was intrigued by relativity because it was so non-intuitive, and I considered it a challenge. Science is a process, and this idea stood out in Naresh's lectures. Now, after many years of experience, I realised why this was so. The keen edge to his lectures came from the front-line research he was engaged in at the time. This gets invariably conveyed to the students in lectures. The moral of the story is that teachers should also be researchers so they can pass on the right message to students.

Naresh inspired me to pursue science as a career. He was my first mentor. The second was Prof. Jayant Narlikar [my PhD supervisor], from whom I learnt a lot about performing research, and the third was Prof. Bernard Schutz, with whom I spent a year in Cardiff, U.K., as a senior SERC scientist, and who taught me to be a professional.

As a collaborator: Ten years later, from 1983 onwards, we again interacted on the

Penrose process, or more specifically, the magnetic Penrose process. While at T. I. F. R., Mumbai, I became interested in electromagnetic fields around black holes. Specifically, I was interested in the field produced by a current loop in the equatorial plane of a rotating [Kerr] black hole. There was not only a magnetic field produced, which would have been the case in flat space-time, but there was also an electric field. This is because of the rotation inherent in Kerr geometry. I was enthralled by the beauty of how, in general, a curved space-time changes the electric and magnetic fields compared to those in flat space-time, and made efforts to understand this. When Naresh visited T. I.F.R., I discussed my computations with him. He immediately expressed keen interest. In fact, he went further. He thought of how this idea could be used to extract energy from a rotating black hole immersed in an electromagnetic field. It was typical of him to put forward ideas which appeared nebulous at first, which he then left to the mortals to crystallise. He pointed the way which the mortals had missed and left it to them to work the ideas out; he was blessed with wonderful imagination - *the magnetic Penrose process was conceived*. In the magnetic Penrose process, energy is not only extracted from the rotation of the black hole, but also from the electromagnetic field. Several of his students, notably Sanjay Wagh, and I were involved and carried out research on this idea. We published several papers - perhaps a dozen or so, which culminated in PhD and M. Phil degrees. The magnetic Penrose process was not unlike the Blandford-Znajek process, which also extracts energy from a rotating black hole surrounded by

matter and could be used to power energetic astrophysical processes. I count this as one of our major achievements.

Gravitational waves: I joined IUCAA on 1st January 1989 as a faculty member. Naresh strongly encouraged my endeavours to research gravitational waves in India. This was not only in gravitational wave data analysis but also in the construction of a laser interferometric detector on Indian soil [this has finally been realised after three decades with the LIGO-India project]. First, he bequeathed his two postdocs, Dr B. S. Sathyaprakash and Dr Patrick Dasgupta, to work with me on gravitational waves. We [Dhurandhar, Dadhich & Narlikar] wrote a proposal to DST for constructing a laser interferometric detector in India, tens of metres in arm-length. The DST turned down the proposal because we were all theorists [have you ever held a screwdriver in your hand?] and advised us to hold a workshop, inviting experts, and more importantly, experimentalists, from India and abroad. I organised such a workshop in CAT [now RRCAT], Indore, in 1990. Dr Bhawalkar was the director of CAT at the time, and he strongly encouraged the enterprise despite the technology not being in place. At every step in the workshop, I relied on Naresh's advice and guidance.

As a friend: At the beginning of 1984, I did not have a job [TIFR did not want me]. Naresh convinced the head of the mathematics Dept. Pune University to offer me a visiting fellowship for six months [In December 1984, I secured a lectureship in the Physics Dept., Pune University]. He was my safety net and helped me tide me over the lean period.

I cannot forget the barbecues which we used to have in the mid '80s on the terrace of my house. This was before IUCAA was born. His students and family used to participate enthusiastically in this pleasurable activity. It continued into the early 90's, after IUCAA had formed and the group's size expanded. This was especially so during the New Year celebrations.

Closing: He had many dimensions to his personality. His friendliness and networking skills led to several fruitful and important collaborations, both nationally and internationally. Along with Ajit Kembhavi, he spearheaded efforts to

involve Indian universities with IUCAA and to make them aware of the facilities available there. I will not further dwell on his other abilities because others will surely address these better than I.

In closing, Naresh loved doing science and was active in this till his last breath – a dedicated scientist and a marvellous teacher.

Farook Rahaman

IUCAA Visiting Associate

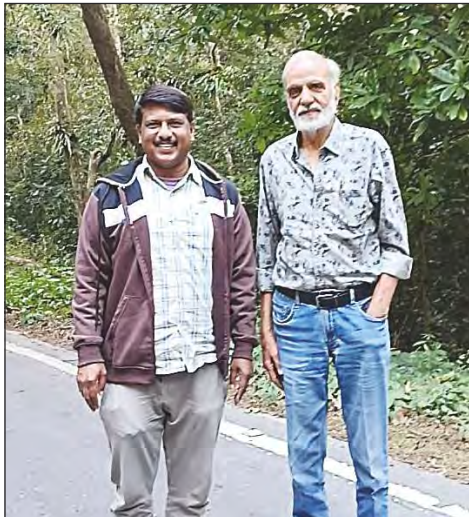
**Professor,
Department of Mathematics
Jadavpur University**

My first encounter with Prof. Naresh Dadhich dates back to my Ph.D. days, when I attended GR15 at the Inter-University Centre for Astronomy and Astrophysics [IUCAA]. It was my very first visit to IUCAA.

During the busy hours of the conference, I noticed a tall, dignified personality quietly monitoring every aspect of the program. He seemed to be everywhere at once—ensuring that sessions ran smoothly, addressing participants' concerns, and resolving problems with remarkable calmness and sincerity. His composed authority and gentle efficiency left a deep impression on me.

Later, I came to know that this commanding yet humble figure was Prof. Naresh Dadhich.

Over the years, I had the opportunity to see him many times at IUCAA and at various seminars. What always struck me was his



extraordinary clarity of thought. Whenever I approached him with questions – sometimes even doubts that felt almost elementary—he would respond with such patience and simplicity that complex ideas in relativity suddenly felt like school-level concepts. That rare ability to simplify the deepest physics is the mark of a true teacher.

His command of general relativity and theoretical astrophysics was astonishing. He did not merely know physics—he seemed to live it.

In 2014, when we proposed the theoretical possibility of galactic wormholes and our work received significant media attention and sparked debate, Prof. Dadhich engaged with us critically and thoughtfully. Those discussions were never confrontational; rather, they were intellectually rigorous, constructive, and deeply enriching. He challenged ideas not to dismiss them, but to refine them.

The last time I met him was in 2024 at Cooch Behar Panchanan Barma University. Even then, he remembered our work on galactic wormholes and brought it up with genuine curiosity. What followed was a high-level scientific conversation that broadened my understanding immensely. Interacting with him always meant learning something profound.

Prof. Dadhich combined scholarship with humility, authority with kindness, and depth with accessibility. He was not only a towering figure in Indian relativity research but also a mentor who inspired confidence and curiosity in younger scholars.

His passing is an irreparable loss to the Indian general relativity community. Yet, his legacy lives on—in his science, his



students, and in the countless minds he shaped with his wisdom.

For me personally, he will always remain that calm, reassuring presence at my first conference—the scholar who showed that immensity in science can coexist with simplicity and grace.

May his soul rest in peace. His ideas will continue to guide us.

With profound respect and regards,

B. C. Paul

IUCAA Visiting Associate

**Professor,
Physics Department
North Bengal University, Siliguri**

Prof. Naresh Dadhich was a close friend of the University of North Bengal and a driving force behind the establishment of the IUCAA Reference Centre [IRC] at North Bengal University. Prof. S. Mukherjee, former Coordinator of IRC, NBU, collaborated extensively with him on several frontline research activities in astronomy and astrophysics. Over the years, the activities of the IRC gained momentum and evolved into what came to be known as the IUCAA Resource Centre.

We subsequently set up a Data Centre, from which many research scholars at NBU working in astrophysics and cosmology greatly benefited. This initiative also helped nucleate collaborations with other universities and institutions, leading to the organization of several seminars, workshops, and schools at NBU. In recent times, the centre has been recognized as the IUCAA Centre for Astronomy Research and Development [ICARD].

Prof. Dadhich will always be remembered at ICARD with deep respect, gratitude, and admiration. His presence was not merely that of a colleague or collaborator, but of a guiding force whose commitment, integrity, and intellectual depth significantly enriched the university. Through his association with ICARD, Prof. Dadhich contributed immensely to strengthening academic culture, research orientation, and institutional values. His interactions were marked by clarity of thought, quiet wisdom, and an unwavering dedication to excellence. He firmly believed in nurturing ideas, encouraging young minds, and building meaningful academic partnerships that extended beyond formal boundaries.

For all of us, including Prof. B. C. Paul and others who had the privilege of working alongside him, this association was both an honour and a profound learning experience. His professionalism was matched by his humility, and his leadership by his empathy. He inspired trust, fostered collaboration, and set high standards through personal example rather than authority. I was privileged to collaborate with him, and our association opened new vistas in theoretical astrophysics, especially in the study of neutron stars and cosmology.

Prof. N. K. Dadhich leaves behind a lasting legacy of scholarship, sincerity, and service. His contributions to NBU ICARD will continue to guide and motivate us, and his memory will remain an integral and cherished part of our institutional journey.

Banibrata Mukhopadhyay

**Professor,
Department of Physics
Indian Institute of Science**

I am extremely saddened and speechless. He was like another father to me, apart from being a mentor [forever] and a friend. My heartfelt condolences go out to his loved ones.

The above note reflects my immediate reaction upon learning of the sad demise of Prof. Naresh Dadhich. Subsequently, at the request of the concerned IUCAA committee, I compose the following reminiscence. His passing is an immense



loss to the gravity research community, apart from being a deep personal loss to me. Those who knew Naresh closely are aware of his exceptional academic dedication. Until his very last days, he remained actively engaged in research and continued submitting papers, some of which appeared after his passing. My personal association with him dates back to 2002, when I joined IUCAA as a postdoctoral fellow (although we had met briefly a couple of times before). Coming from a relatively conservative background, I initially addressed him as “Prof. Dadhich” or “Sir,” especially since his age was between that of my parents and I was still quite young, well below thirty. He explicitly urged me to call him by his first name. I still remember that on my very first day at IUCAA, he invited me to dinner at a restaurant outside the campus with some of his friends and colleagues.

During my stay at IUCAA, which lasted about eleven months, we co-authored a paper on the duality of the Kerr–NUT spacetime, related spinor and scalar perturbations, and their consequences. Subsequently, we collaborated on several other projects, including work on baryogenesis and higher-dimensional black hole solutions. All these collaborations were thoroughly pleasant and intellectually rewarding experiences.

Beyond formal collaborations, he always took a genuine interest in my work. He regularly asked about my ongoing research and offered encouragement and support. More than a decade ago, when I published a paper on black hole mass and spin in *Physical Review Letters*, he wrote a commentary in *The Telegraph*, explaining the significance of the result to the broader

public. A few years later, when I edited a special issue of the journal *Universe*, he contributed a review article on the Magnetic Penrose Process and its astrophysical applications.

My interactions with Naresh, however, extended far beyond academic matters. During my time at IUCAA and afterward, we often discussed life, politics, poverty, and social issues. We visited the Max Planck Institute for Gravitational Physics (Albert Einstein Institute) in Gölms together on multiple occasions—my visits were largely possible because he recommended me. We frequently traveled to Berlin, sometimes to meet his friends, and he would insist that I join him. He always treated me with great warmth and affection, as though I were a member of his own family.

I conclude by echoing my earlier sentiment: I feel as though I have lost a family member. This is the first time someone in academia so close to me—academically and personally—has passed away. If I appear emotional, it is with good reason, as I have tried to explain briefly above. I find myself at a loss for words and have little consolation to offer, except to cherish the memories of a remarkable human being and an inspiring scientist.



The Thirty-Seven Foundation Day Lecture



The 37th Annual lecture of IUCAA, titled **"Why yesterday matters for tomorrow: Rethinking the Anthropocene"**, was delivered on December 29, 2025, by Prof. Mahesh Rangarajan, Professor of History and Environmental Studies at Ashoka University and Chair of the Archives of Contemporary India. Prof. Rangarajan is a distinguished academic with a diverse range of expertise. He was educated at Hindu College, University of Delhi, and then at Balliol and Nuffield Colleges, both in Oxford, where he was a Rhodes Scholar. Dr Rangarajan has worked as Assistant Editor at The Telegraph, Kolkata, and has been a commentator on current affairs for audio-visual media in both English and Hindi. He has previously taught at the University of Delhi and at Krea University. He has also been a Visiting Faculty at Cornell University, Jadavpur and the National Centre for Biological Sciences, Bengaluru. He was Director, Nehru Memorial Museum and Library (2011-15), and has also served as Vice Chancellor, Krea University (2021-22). He was the Chair of the Elephant Task Force of the Government of India in 2010 and a member of the Forest Advisory Committee of the Ministry of Environment, Government of India (2008-2012). In his lecture, Prof. Rangarajan elucidated how

human activity has become a driving force in Earth's current geological evolution, with substantial ecological impacts on biospheres. The talk introduced the concept of the Anthropocene, an era in Earth's geological history in which human activity has profoundly impacted the planet. The term Anthropocene was first coined by Prof. Paul Crutzen, who was co-awarded the 1995 Nobel prize in Chemistry, for their studies on the depletion of the Ozone layer. The Anthropocene is part of the broader geological phase called the Holocene, which began after the end of the last ice age, when the human species evolved and flourished, from hunting and gathering to agriculture. Until the beginning of the Industrial Revolution, the primary source of energy in human society was human and animal labour, with some use of above-ground coal and peat. However, a later radical shift in energy needs and the use of fossil fuels led to significant societal transformations, which, in turn, affected the planet and its geology, marking the onset of the Anthropocene. Through several anecdotes, Prof. Rangarajan highlighted that concerted efforts were first undertaken to identify and address such issues in the 1970s and 80s, through major scientific

meetings such as the 1972 United Nations Conference on the Human Environment and the adoption of environmental guidelines in the Montreal Protocol. Such actions provided a shift in acknowledgement and understanding of the effects of human activity on the climate. However, global concerted efforts to address major environmental issues have always been mired in complex geopolitical issues, which are often driven by nations' economic or political ambitions rather than a general goodwill to act against environmental degradation. As an example, Prof. Rangarajan shared how rampant testing of nuclear weapons in the post-World War era had led to widespread effects on ecological biospheres. Radioactive or highly reactive elements such as Strontium were found in polar animals, indicating a large-scale global cycle in which elements generated by nuclear blasts make their way into distant ecological chains. The discovery of such broad effects and concerted action from many stakeholders led to the nuclear testing. However, such actions were often met with significant inertia and challenges. Communicating the urgency in simple, non-technical language to stakeholders is usually necessary, and highlighted a light-

hearted interaction between Indian scientific delegations and the then President of the United States of America as an example. The global consensus on definitive action to address climate remains a far more challenging problem. The challenges primarily stem from the disparate economic progress of countries that were once colonised by other nations, leading to divergent growth rates. Although colonial rule has largely ended in the present age, centuries of historical suppression and forced exploitation of natural resources to benefit some nations over others disparately have led to unbalanced development and growth. Climate policies must take into account complex historical and geopolitical factors to enable fair growth while simultaneously addressing the dangers posed by global warming. Prof. Ranganathan gave several examples of forced human intervention in agricultural activities that have changed the native biomes. An example was the

introduction of rubber plantations from Brazil to Malaysia, which has now become a significant source of revenue for the Southeast Asian country. In all such cases, when large-scale forced agricultural activities have been undertaken. However, such forced changes often lead to the decline and devastation of native ecological systems to promote a few restricted species. Rapid development has also led to widespread deforestation in regions such as the Congo and the Amazon. While such activities may benefit economically, they also cause other long-term problems, such as loss of ecological diversity and groundwater depletion. All such actions are examples of the Anthropocene, in which human activities shape the planet's geological and ecological map. Policies favouring rapid,

short-term growth often lead to unintended long-term changes. Prof. Ranganathan gave an example of how the Great Leap in China led to a short-term increase in crop yields, followed by a large-scale decline, famine, the loss of animal and bird habitats such as sparrows, and spiralling casualties. Prof. Ranganathan elucidated how humans have been a driving force in shaping many aspects of the planet's evolution in the last few centuries. In conclusion, Prof. Ranganathan said that acknowledging such actions will help shape future policies to better sustainable growth, while accounting for the varied and fair ambitions of all nations with different growth trajectories. The audience much appreciated the enlightening talk, and a lively interaction followed.

The recorded lecture is available at the YouTube link:

https://www.youtube.com/live/OkcCAV1xphY?si=0Lrs_9X63eu_c2FB

Research Highlights

Mapping Cold Gas Across the Universe: The MeerKAT Absorption Line Survey

A Milestone Reached, and What Comes Next

The MeerKAT Absorption Line Survey [MALS; <https://mals.iucaa.in/>], first proposed 15 years ago, has reached a defining moment: all 1,400 hours of observations, spread over five years, were

completed at the end of 2025. MALS was one of just ten Large Survey Projects selected to take advantage of MeerKAT in its early years. MeerKAT is itself a precursor to the Square Kilometre Array (SKA), the next-generation radio observatory under construction in South Africa and Australia. MALS is therefore not only delivering

frontier science but laying the groundwork for the SKA era. With three major data releases already public and more to follow, it is set to enhance our understanding of how galaxies grow and regulate star formation across cosmic time.

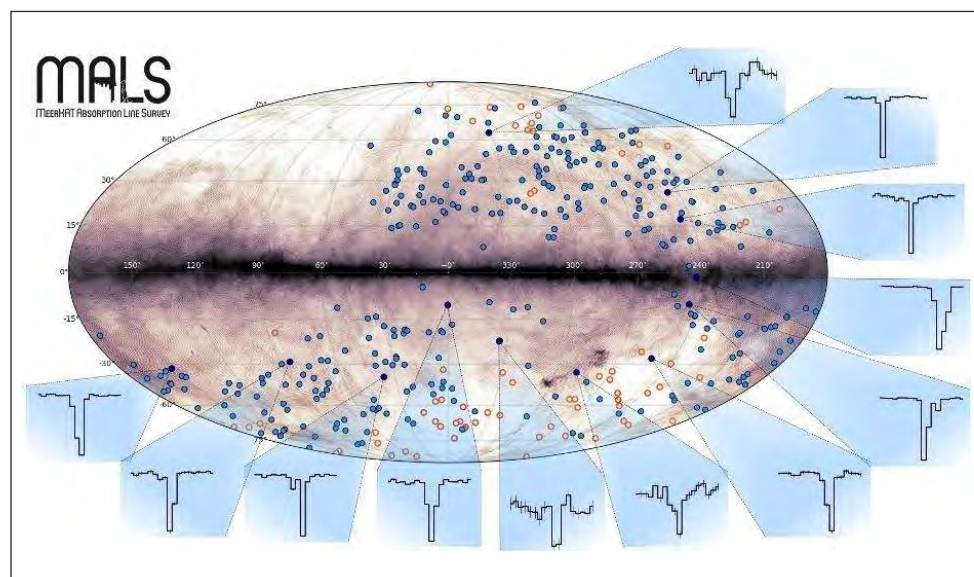


Figure 1. Full-sky map in Galactic coordinates showing 21-cm emission from the Milky Way [HI4PI survey]. Circles mark 391 MALS pointings; insets show absorption signals from cold hydrogen clouds detected by MALS. [Credit: MALS / IUCAA/SARAO]

Why Cold Gas Matters

Hydrogen emits and absorbs radio waves at 21 centimetres. Emission traces both warm and cold gas indiscriminately, but absorption reveals specifically the cold, dense pockets that are the precursors to star formation. It does so by detecting the faint dip in the spectrum of a background radio source, caused by intervening foreground gas. MeerKAT is the most sensitive radio telescope at centimetre wavelengths, making it uniquely capable of detecting these faint absorption signals across a large area of sky. By detecting absorption toward tens of thousands of background radio sources and combining this with other existing multi-wavelength data, MALS can determine not just how much hydrogen fuel galaxies contain, but what fraction is actually cold enough to form stars: a key to understanding why the Universe's star formation rate has fallen tenfold over the past ten billion years.

MeerKAT and the Data Challenge

MeerKAT's unmatched sensitivity and wide field of view make it uniquely suited to this task, capturing dozens of background radio sources per pointing and covering the frequency range needed to detect redshifted 21-cm absorption across more than 70 percent of the universe's history. The survey's approximately 400 pointings generated 1.6 petabytes of raw data, a volume that demanded specialised infrastructure. The MALS team designed and led the development of a fully automated processing pipeline. It was built in collaboration with ThoughtWorks Technologies India, a productive example of academia-industry partnership bringing together expertise in radio astronomy and software engineering. The entire data hosting and processing infrastructure, from high-capacity storage to the compute clusters running the data processing pipeline, was set up and is maintained at IUCAA in Pune. The pipeline serves as a strong example of how large-scale radio surveys can be handled end-to-end and offers a template for future efforts of this kind.

Million sources, Cosmic Dipole and Cold Gas

The first data release [2023] catalogued

495,325 radio sources over 2,289 square degrees of sky. Most are AGN, and many were detected for the first time. These sources, the brightest background radio objects in the survey footprint, form the targets against which the absorption line searches are being conducted.

The second data release [2024] expanded the continuum catalog to nearly one million sources, the largest produced by any MeerKAT survey, and yielded a striking cosmological result. Using this catalog, the team measured the cosmic dipole: a subtle asymmetry in the sky distribution of radio sources caused by the motion of our Solar System through the Universe [see Fig. 2]. Over the past decade, most such measurements have found the effect to be significantly larger than standard cosmological models predict. The MALS result was fully consistent with predictions, an outcome apparently linked to the survey's strategy of going very deep over small patches of sky, capturing faint ordinary galaxies that shallower surveys miss. The mystery is not yet resolved. Forthcoming MALS data releases, including deeper catalogs from the lower-frequency UHF band of MeerKAT, will address it further.

The third data release [April 2025] delivered the most comprehensive catalog of cold hydrogen in the Milky Way ever assembled: approximately 3,500 detections of 21-cm absorption, a tenfold increase over all previous surveys combined. This catalog was combined with 21-cm emission, far-infrared, and optical maps, a multi-wavelength approach that is central to the MALS science strategy. Together, these data allow the team to disentangle the warm and cold components of the interstellar gas and trace filamentary structures of hydrogen flowing in and out of the galactic disc in unprecedented detail. They also allow the team to relate the properties of cold gas to local conditions such as radiation fields and turbulence driven by stellar activity, building a more complete picture of the conditions that regulate star formation.

Looking Ahead

Completion of observations marks a beginning, not an end. The data releases so far have been primarily based on MALS L-band observations (900 to 1670 MHz). The UHF band (580 to 1015 MHz) data are now coming to the fore, bringing deeper continuum images, richer spectral line

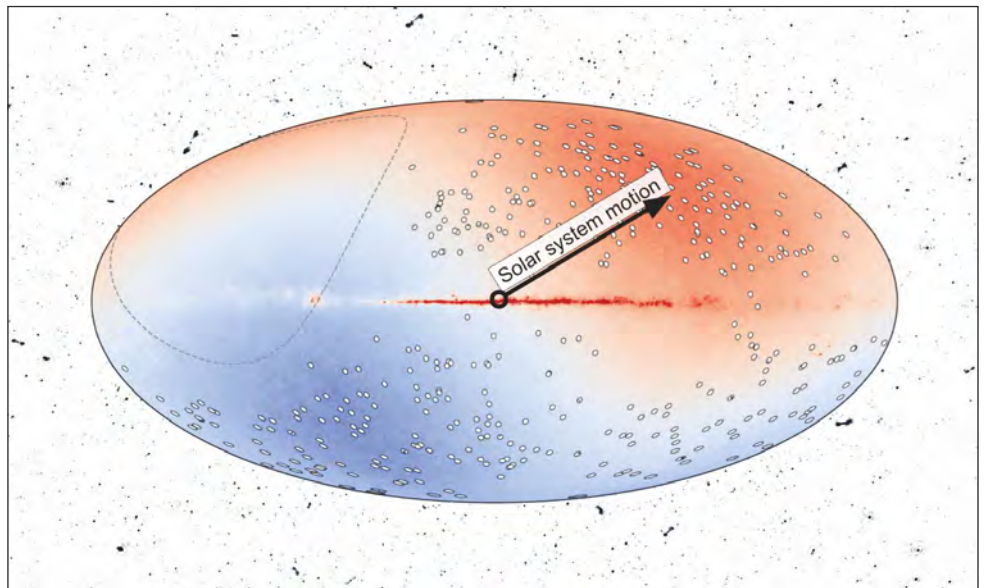


Fig. 2 A map of the sky overlaid on a portion of single MeerKAT pointings containing a few thousand radio sources. In the sky map, circles mark positions of 391 pointings containing a total of 971,980 sources. The arrow shows the direction of the cosmic dipole originally established by measurements of the cosmic microwave background radiation. The dipole effect will make the sources appear more numerous [red portion] in the direction of the motion and less numerous in the opposite direction [blue portion]. [Credit: MALS / IUCAA / SARAO]

coverage, and sensitivity to higher redshifts. This allows MALS to probe cold gas in galaxies at epochs when the Universe was actively building up its stellar mass. Upcoming releases will include 21-cm and OH absorption lines from these more distant galaxies, extending the survey's reach to the peak epoch of cosmic star formation. The pipelines, data strategies, and trained researchers that MALS has produced are also feeding directly into preparations for the SKA, ensuring that this survey's legacy extends well beyond its own results.

Ensuring that these data reach the widest possible community is a priority. The MALS data products, hosted at IUCAA, are already mirrored at the Open Science Data Federation [OSDF], a US-based distributed data infrastructure that connects storage endpoints at universities, national labs,

and observatories into a single federated network. A mirror is also being established at the German Centre for Astrophysics [Deutsches Zentrum für Astrophysik, DZA] in Görlitz, Germany. DZA is a new large-scale national research centre currently in its build-up phase and set to become a major hub for data-intensive astronomy. Together, these mirrors ensure that researchers across different parts of the world have fast, local access to MALS data products.

The MALS survey footprint was designed from the outset with multi-wavelength synergy in mind, with significant overlap with major optical spectroscopic surveys including SDSS, 4MOST, and DESI. This overlap means that the cold gas properties revealed by MALS can be directly connected to galaxy redshifts, star formation rates, and chemical abundances

measured at optical wavelengths, enabling a far richer scientific return than radio data alone could provide.

The ongoing work to improve multi-wavelength coverage and publicly release even larger datasets and catalogs will continue to foster broad scientific engagement in the years ahead, ensuring long-term legacy of the survey.

The MeerKAT Absorption Line Survey [MALS] is led by Neeraj Gupta at the Inter-University Centre for Astronomy and Astrophysics [IUCAA], Pune, India. Full details on all aspects of the survey, its science goals, and data releases are available at <https://mals.iucaa.in>. The MeerKAT telescope is operated by SARAO, a facility of the National Research Foundation [NRF] of South Africa.



Neeraj Gupta is a Professor at the Inter-University Centre for Astronomy and Astrophysics [IUCAA] in Pune, India, where he has been based since 2013. He obtained his PhD from the National Centre for Radio Astrophysics, TIFR, in 2007, and subsequently held postdoctoral positions at the Australia Telescope National Facility in Sydney and the Netherlands Institute for Radio Astronomy [ASTRON] in Dwingeloo. His research focuses on the evolution of cold atomic and molecular gas in galaxies, studied through radio absorption lines with current and upcoming large radio telescopes. He is the Principal Investigator of the MeerKAT Absorption Line Survey [MALS], one of ten Large Survey Projects carried out with the MeerKAT telescope in South Africa, designed to trace the evolution of cold gas in galaxies across more than 70 percent of the universe's history.



The Impact of Low-Metallicity Environments on Star and Planet Formation

Star and planet formation are two fundamental and intrinsically linked processes in astrophysics, connected through the presence of a protoplanetary disk. Stars form via the gravitational collapse of rotating clouds of gas and dust. Conservation of angular momentum during this collapse leads to the formation of a circumstellar disk around the newborn star. This disk, composed of gas and dust, is known as a protoplanetary disk and contains the raw material from which planetary systems subsequently emerge. Radiation from the young central star interacts with the disk, regulating its structure, evolution, and ultimately the

efficiency and pathways of planet formation. The star-disk-planet connection is therefore particularly compelling, as it provides the key framework for understanding the remarkable diversity of exoplanetary systems currently being discovered.

Star and planet formation are fundamentally shaped by their environment, with metallicity as a key parameter regulating the thermal, chemical, and dynamical evolution of molecular clouds, protostars, and protoplanetary disks. Low-metallicity environments, characteristic of the outer

Milky Way, dwarf galaxies, and the early Universe, provide a unique laboratory to investigate star formation under conditions distinct from the solar neighbourhood. Metallicity influences gas cooling, dust abundance, opacity, ionization fraction, and radiative feedback, thereby affecting cloud fragmentation, accretion processes, disk lifetimes, and ultimately planet formation efficiency [Krumholz 2014]. Understanding how star and disk evolution proceed in metal-poor environments is therefore essential for connecting local star formation to cosmic star formation history and the origins of planetary systems.

Theoretical Predictions for Protoplanetary Disk Evolution at Low Metallicity

Metallicity plays a central role in determining disk structure and evolution by modifying dust-to-gas ratios, opacity, and thermal balance. In metal-poor disks, reduced dust content lowers opacity, allowing stellar and external ultraviolet radiation to penetrate deeper into the disk. This enhances photoevaporation, particularly driven by far-ultraviolet (FUV) photons, potentially leading to rapid disk dispersal. At the same time, theoretical models predict higher protostellar accretion rates at low metallicity. Reduced cooling efficiency and higher ionization fractions can increase disk scale heights and enhance angular momentum transport, promoting more vigorous accretion [Öberg et al. 2023, Machida & Nakamura 2015]. These competing effects—enhanced accretion versus accelerated photoevaporation—suggest shorter disk lifetimes overall in metal-poor environments [Gehrig et al. 2023] (Fig 1). An alternative theoretical pathway proposes that lower opacity may suppress magnetohydrodynamic turbulence, reducing effective viscosity and prolonging disk lifetimes by slowing viscous evolution [Durisen et al. 2007]. This dichotomy

highlights the sensitivity of disk evolution to the detailed interplay between thermodynamics, ionization, and radiation fields, and underscores the need for observational constraints.

Observational Evidence: Protoplanetary Disk Accretion and Disk Lifetimes

Observational studies of low-metallicity disks reveal a complex and sometimes contradictory picture. In the Magellanic Clouds [$Z \sim 0.2-0.5 Z_{\odot}$] HST photometric studies consistently report enhanced mass accretion rates compared to solar-metallicity regions [Vlasblom & De Marchi 2023 and references therein]. These results suggest prolonged or more efficient accretion in metal-poor environments. In contrast, spectroscopic studies of Galactic low-metallicity regions find accretion rates comparable to solar-metallicity trends and no significant metallicity dependence in accretion luminosities [Ashraf et al. 2025 & references therein]. Disk fraction [fraction of young stars with disk in a given star forming complex] studies further deepen this tension. Near-infrared excess surveys of low-metallicity clusters in the outer Milky Way report low disk fractions, implying rapid disk dispersal [Patra et al. 2024]. This discrepancy likely reflects the

use of different diagnostics: infrared excess traces warm inner dust, whereas H α and UV excess probe ongoing gas accretion. Low metallicity may accelerate dust depletion while allowing gas accretion to persist, decoupling dust and gas disk lifetimes

Implications for Planet Formation

Because protoplanetary disks provide the material reservoir for planet formation, metallicity-dependent disk evolution has direct consequences for planetary systems. Exoplanet surveys demonstrate a strong correlation between host-star metallicity and giant planet occurrence [Fulton et al. 2021], consistent with core-accretion models. Shorter dust disk lifetimes at low metallicity may hinder planetesimal formation, while prolonged gas accretion could still permit the formation of low-mass or gas-poor planets. Thus, low-metallicity environments may preferentially form compact, low-mass planetary systems rather than gas giants, offering insights into planet formation pathways in the early Universe and metal-poor galaxies.

In Summary, Low-metallicity environments profoundly influence star formation and protoplanetary disk evolution, but current theoretical and observational results remain inconclusive and sometimes contradictory. While theory predicts enhanced accretion and accelerated disk dispersal, observations reveal both rapid dust depletion and prolonged gas accretion, depending on diagnostics and environment. Future progress will require coordinated multi-wavelength surveys combining infrared, millimeter, and spectroscopic accretion diagnostics, alongside improved simulations incorporating radiation, chemistry, and magnetic fields. The outer Milky Way, with its well-characterized metallicity gradient, stands out as a critical laboratory for bridging Galactic and extragalactic star formation studies.

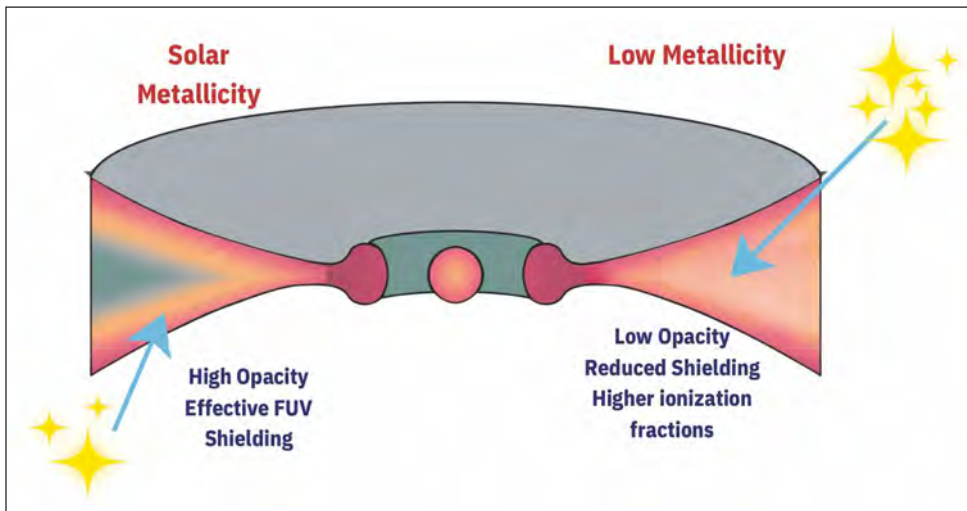


Fig 1. Schematic illustration of the impact of metallicity on dust opacity and FUV shielding of the protoplanetary disk. In solar-metallicity environments [left], high dust opacity provides effective shielding from external and internal radiation, preserving dense midplane of the disk. In contrast, in low-metallicity environments [right], the reduced dust content results in lower opacity, weaker shielding, and higher ionization fractions, making the disk more susceptible to internal and external feedback [Credit: PhD Thesis, Mizna Ashraf, IISER Tirupati].

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Dr. Jessy Jose is an Associate Professor in the Department of Physics at the Indian Institute of Science Education and Research (IISER) Tirupati. Her primary research focuses on star and planet formation using multi-wavelength observational techniques, with particular emphasis on the properties and evolution of protoplanetary disks, brown dwarfs, and free-floating planetary-mass objects. She has a strong interest in understanding how low-metallicity environments, especially in the outer Milky Way, influence star and planet formation.



Tides in black holes

Einstein's general theory of relativity makes exciting predictions about cosmology and various astrophysical objects, with black holes arguably as the simplest and most mysterious among them. Recent observations of gravitational waves (GWs) by the LIGO-Virgo-KAGRA collaboration, the images of the shadows cast by supermassive black holes by the Event Horizon Telescope collaboration, and the observation of the motion of the star near the centre of our Galaxy are strongly suggestive of the existence of black holes. With the advent of next-generation detectors and observatories, with ever improving sensitivities, we hope to see more of them and be able to measure their properties with better precision. Thus, these observations will demand better modeling of these objects and careful studies of the properties of black holes.

The response of a black hole (BH) to an external tidal field is one such property. In the recent past, the tidal response of neutron stars was used to unravel their composition, i.e., the equation of state. In the same spirit, investigating the analogous response of BHs will help us test the classical black hole paradigm and,

presumably, improve our understanding of compact objects, in general.

The tidal response of any self-gravitating body can be divided into two parts: conservative and dissipative. The conservative part contains information about the tidal deformation of the body, while the dissipative part describes the dissipation of energy and angular momentum due to that response. We can associate dimensionless numbers with these parts, known as tidal Love numbers (TLNs) and tidal dissipation numbers, respectively. This response is typically studied both in the static and dynamic scenarios. In the static case, the self-gravitating object and the tidal field are fixed in the reference frame of an external observer, while in the dynamic case, the self-gravitating object and the tidal field move relative to each other in the external observer's reference frame.

Various studies have found vanishing *static* TLNs for non-rotating (specifically, Schwarzschild) and rotating (Kerr) BHs, in General Relativity. In contrast, the exploration of the *dynamical* TLNs of BHs is still in progress. Beyond General Relativity,

BHs in lower (Bañados-Teitelboim-Zenelli black holes in 2+1 dimensions) and higher (Myers-Perry black holes, braneworld black holes) dimensions than 3+1 have non-vanishing *static* TLNs. Furthermore, neutron stars, in General Relativity, also have non-vanishing TLNs.

In our works, we mainly analysed the tidal response of non-rotating (Schwarzschild) and rotating (Kerr) BHs. We found that the Schwarzschild and Kerr BHs have vanishing static TLNs. However, Kerr black holes have non-vanishing dynamical TLNs, in general. In particular, non-extremal and extremal Kerr BHs have non-vanishing dynamical TLNs for non-axisymmetric tidal fields, while they vanish for axisymmetric tidal fields. In addition, we found that the Schwarzschild and slowly rotating BHs have vanishing dynamical TLNs. We hasten to clarify that these analyses of dynamical TLNs are done up to the linear order of the frequency associated with the tidal field, using the Teukolsky equation. The Teukolsky equation describes the perturbation of the Kerr BH to scalar, electromagnetic, fermionic (neutrino) and gravitational tidal fields. To analytically solve the complex Teukolsky equation, we

used the adiabatic and near-zone approximations.

Implications of these results for gravitational wave astrophysics and tests of gravity are potentially far-reaching: The detection of non-zero [dynamical] TLNs via GWs from a binary of spinning compact objects cannot continue to conclusively prove that the components are non-BHs, such as neutron stars. This will be especially confounding for black holes that have masses similar to neutron stars. Since binary BH waveform models employed to date assume vanishing TLNs for black holes, our results imply that a systematic deviation from them would

emerge in the waveform phase. On the other hand, binary components clearly heavier than neutron stars are most likely black holes. Our prediction for their non-vanishing dynamical TLNs should be unequivocally discernible in those systems. Since this is a weak effect, detecting it in our observations would require combining multiple signals. Future detectors, potentially involving LIGO-India, would observe them with higher significance. Establishing their presence will lead to a more complete understanding of what it means to be a black hole.

Acknowledgement: The author would like to thank Prof. Sukanta Bose for checking

the draft of the manuscript and suggesting changes.

References: The above text mainly discusses the work listed below. Also check the references therein.

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Rajendra Prasad Bhatt is a Research Associate at IUCAA, Pune. He completed his Ph.D. under the supervision of Prof. Sukanta Bose and Prof. Sumanta Chakraborty. His research interests include tidal effects in compact objects, gravitational-wave parameter estimation, and analog gravity models.



Testing the Nature of GW200105 by Probing the Frequency Evolution of Eccentricity

Gravitational waves [GW] are ripples in space-time. They distort the space between any two points when they pass through and lead to a change in the distance between those points [stretching and squeezing of space]. To detect these waves, we detect these changes in the arms of the detectors when the gravitational waves pass through them. One of the processes [among many] responsible for the production of these waves is the merger of a black hole and a neutron star - GW200105 is one such event observed in the LIGO-Virgo-KAGRA's third observing run. In general, one expects the orbits of such binaries to become nearly circular when they merge due to loss of energy and angular momentum

via GW emission. However, in dense environments, such as star clusters, they can have some residual eccentricity due to interaction with other systems. At first glance, GW200105 looked like a relatively standard merger. But as astrophysicists dug deeper about how "circular" or "eccentric" [oval-like] its orbit was before it merged, they found that it could be eccentric. However, there are certain astrophysical and beyond General Relativistic [GR] effects as well - such as the time-dependent Doppler shift due to the motion of the center-of-mass of the binary - that can mimic a non-zero eccentricity. Therefore, a reliable measurement of eccentricity becomes of immense importance especially because

the shape of the orbit can be indicative of how the system formed, as discussed above. In "Eccentricity evolution consistency test to distinguish eccentric gravitational-wave signals from eccentricity mimickers", jointly led by Sajad A. Bhat [a postdoc at IUCAA] and myself, we formulated an eccentricity evolution consistency test [EECT] to distinguish a spuriously inferred eccentric signal from a real eccentric signal. It is based on the expectation that even though eccentricity mimickers can imitate eccentricity, they may not mimic its evolution with frequency. Specifically, the method compares the eccentricity recovered at some low frequency value [e.g., 10 Hz], evolved to higher frequencies

assuming GR, with eccentricities recovered at those same higher frequencies. Discrepancy between the two eccentricities at any reference frequency would violate EECT and indicate the presence of a mimicker. In my recent work “Testing the Nature of GW200105 by Probing the Frequency Evolution of Eccentricity”, we [Avinash, Sajad, Arif, and Shasvath] have applied this test to GW200105 and found that it satisfies EECT within 68% confidence. Our analysis lends complementary support in favor of the eccentricity hypothesis, while also providing a novel test of the consistency of $e[f]$ with GR. The left panel of Figure 1 shows the violins of the eccentricity

deviation δ_e at each of the reference frequencies chosen, except $f_{\text{ref}} = f_0 = 18$ Hz, where δ_e is consistent with zero by design. A complementary right panel in Figure 1 shows the individual observed [right side] and predicted [left side] posteriors. We found that these are all consistent with each other, as expected. Our work, therefore, added a complementary support in favor of the eccentricity hypothesis for this event, with no evidence to suggest the presence of an eccentricity mimicker. It is the first waveform-model-independent test of the eccentric nature of GW200105’s orbit, while also demonstrating consistency of the signal with the GR-predicted frequency evolution of

eccentricity, thus acting as a novel test of GR on this event. The advantage of EECT over conventional Bayesian model-selection methods is also amply demonstrated in this work. First, we did not require the plethora of alternative hypotheses to ascertain that the eccentricity hypothesis is favored over others, thus saving on time and computational costs. Moreover, the uncertainty of whether all possible hypotheses that could mimic eccentricity have been considered does not apply here, as it would in a Bayesian model-selection approach.

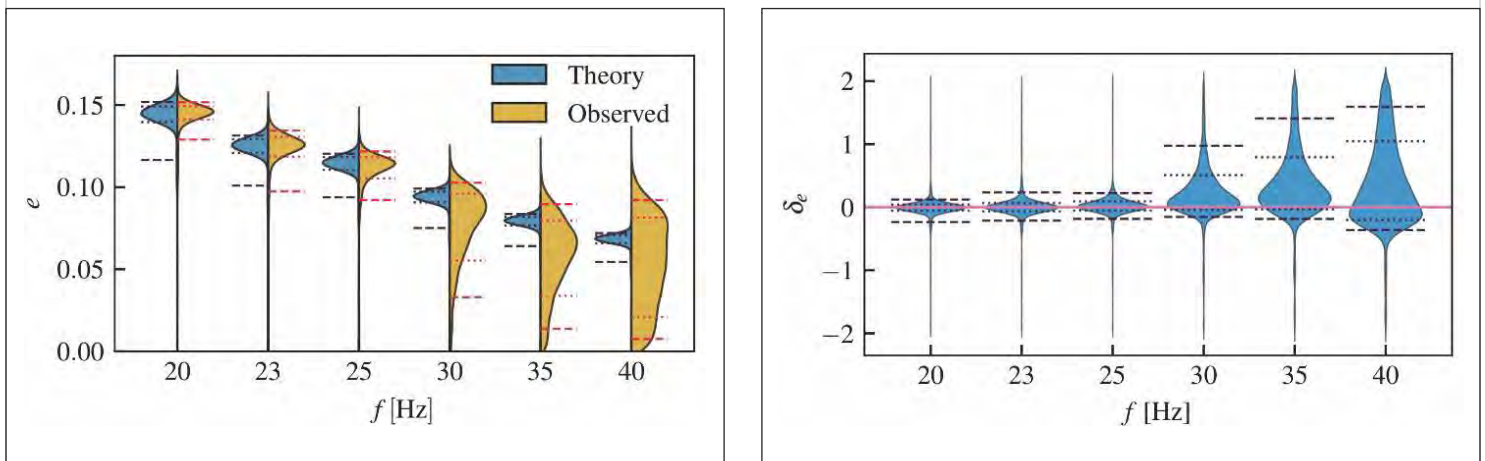


Figure 1. Left: violins of the eccentricity deviation δ_e at different reference frequencies. The horizontal line at $\delta_e = 0$ represents zero deviation from GR. Right: individual observed [right side] and predicted [left side] posteriors at different reference frequencies for the same. In both panels, the dashed and the dotted lines represent the 90% and 68% credible intervals, respectively.



Avinash Tiwari is a Research Scholar at IUCAA. His work focuses on several aspects of gravitational-wave [GW] theory and data analysis, with particular emphasis on techniques such as Fisher matrix analysis, parameter estimation, and hierarchical inference. His research also involves GW waveform modeling, particularly the development of line-of-sight acceleration [LOSA] waveforms, probing merger environments on a single-event basis, developing model-independent tests to characterize GW signals, and exploring the early Universe using gravitational waves and 21-cm cosmology.



Events at IUCAA

GW – Detector Characterisation Workshop



With successive improvements in sensitivity, data from the LIGO detectors have increasingly been affected by new transient noise artefacts, often of unknown origin. Efforts to understand and mitigate such noise artefacts in both the instruments and the data are collectively referred to as detector characterization.

The GW – Detector Characterisation Workshop, held from December 15–19, 2025, and coordinated by Anupreeta More [IUCAA] and Shivaraj Kandhasamy [IUCAA], was organized with the primary objective of providing an introduction to gravitational-wave detector characterization. This area is essential for enhancing detector performance and, consequently, improving the sensitivity of gravitational-wave [GW] searches. Although India has a large community specializing in the development of search algorithms and the analysis and modelling of GW signals, relatively few researchers are currently engaged in detector characterization. Developing local expertise in this domain is particularly critical in the context of the upcoming LIGO–India detector.

The resource persons offered a comprehensive overview of various aspects of detector characterization and associated tools, encouraging members of the Indian GW community to undertake research problems in this area. Such

efforts are especially important during the commissioning phase of LIGO–India.

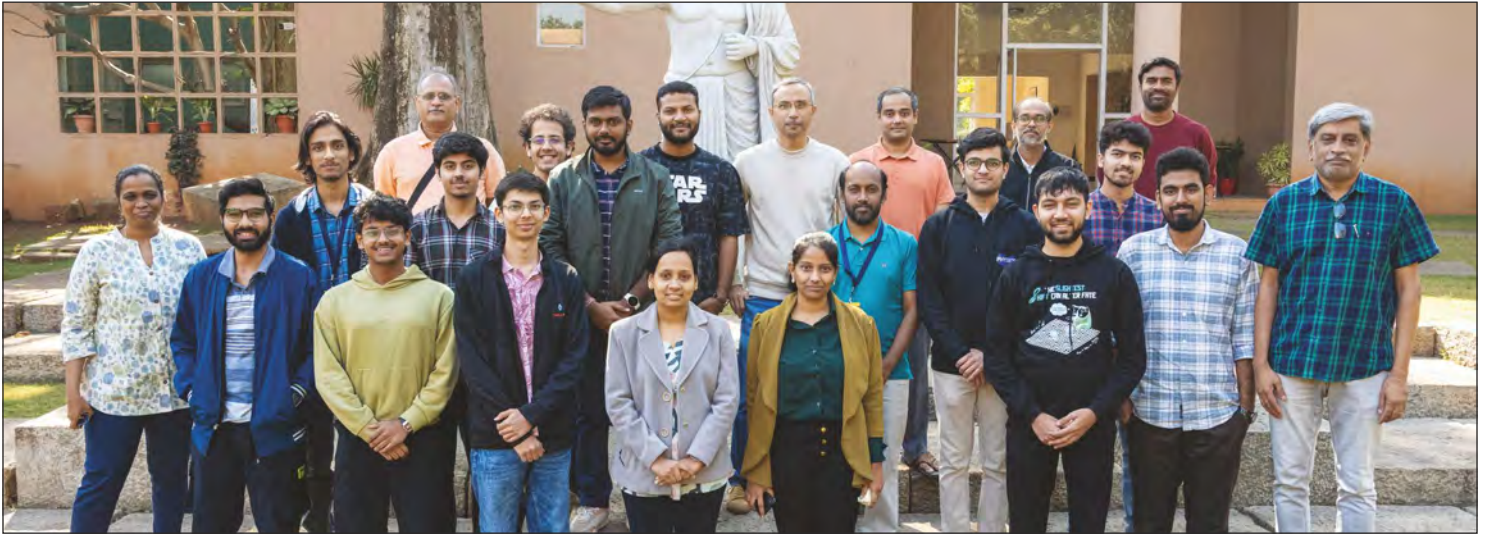
Approximately 40 participants attended the workshop, most of whom had prior research experience in gravitational-wave science and are well positioned to contribute to detector characterization activities in the future. The participants included around 20 faculty members or senior scientists and 20 junior researchers, such as postdoctoral fellows, Ph.D. scholars, and master's students. They represented a wide range of institutions, including IUCAA, IIT Bombay, IPR, TIFR, RRCAT, IIT Indore, CMI, IISER Kolkata, NIT Calicut, and several other prominent research and educational institutes across India.

While a number of lectures were delivered remotely by LIGO experts from the United States and Europe, several international experts also participated in person to deliver lectures on diverse topics related to detector characterization. In addition, multiple hands-on tutorial sessions were conducted, providing participants with practical experience in using various Python-based software packages employed within the LIGO collaborations. These sessions included exercises such as identifying different types of noise features and generating and analyzing diagnostic plots.

In addition to the technical sessions, two of the resource persons, Francesco Di Renzo and Evan Goetz, delivered outreach-oriented lectures aimed at a broader audience. Di Renzo presented an institute seminar summarizing the latest results from the LIGO–Virgo–KAGRA [LVK] Collaboration based on data from the first part of the fourth observing run. He highlighted several notable GW events, including the most massive binary black hole merger observed to date and a binary black hole event that provided confirmation of the Hawking radiation law. He also emphasized the critical role of detector characterization in enabling robust inference of GW signals and in strengthening confidence in these detections.

Even Goetz delivered a public lecture focusing on the observation of gravitational-wave signals and the associated experimental challenges. He reviewed the history of the LIGO detectors and discussed how continuous improvements in their sensitivity over the past two decades have made gravitational-wave astronomy possible. He further outlined the prospective role of LIGO–India and other next-generation detectors in shaping the landscape of gravitational-wave detection in the coming decade.

Gravitational Wave Instrumentation Workshop



The second Gravitational Wave Instrumentation Workshop (GWIW) was conducted over a two-week period from November 30 to December 13, 2025. The workshop was organized and co-developed by *Shasvath J. Kapadia*, with invaluable support from the IUCAA Director, R. Srianand. In addition, Manasa P. Thirugnanasambandam, Ravi Kesharwani, Sanjit Mitra, T. R. Saravanan, Shivaraj Kandhasamy, and Suresh Doravari served as resource persons and played a principal role in the development and execution of the workshop. A total of 15 participants

were selected for the program.

The workshop is a unique initiative of IUCAA, undertaken in view of the LIGO-India mega science project, with the objective of developing instrumentation expertise, promoting gravitational-wave science across India, and fostering a Pan-Indian gravitational-wave community. The program provided selected participants with access to miniaturized versions of cutting-edge instruments used in the LIGO detectors for gravitational-wave observations. What distinguishes this

workshop from other gravitational-wave programs is its strong emphasis on hands-on training. Participants spent several hours each day in the laboratory working with these instruments, acquiring data, and performing analyses. The response was overwhelmingly positive, with participants highlighting the rare opportunity to work with state-of-the-art equipment, complemented by the strong pedagogical foundation provided through lecture sessions. The workshop is planned as a biannual event, with the next edition scheduled for the summer of 2026.

Stellar Variability: Taking the Pulse of the Universe



An international meeting titled Stellar Variability: Taking the Pulse of the Universe was successfully held at the Inter-

University Centre for Astronomy and Astrophysics (IUCAA) from November 24–28, 2025. The event hosted

approximately 100 participants, including 48 foreign nationals, and was coordinated by *Anupam Bhardwaj* (IUCAA). Focused on

stellar astrophysics, the meeting brought together renowned experts and eminent researchers working on various aspects of stellar variability, stellar models, and stellar populations, as well as scientists involved in ongoing and upcoming large astronomical surveys and observational facilities.

The five-day meeting featured nine scientific sessions comprising 20 review and invited talks, 44 contributed oral presentations, and 30 poster presentations. The review talks focused on variability science with the European Gaia space mission, star and planet formation, state-of-the-art stellar evolution and pulsation models, studies of the Milky Way and Local Group galaxies, and current and upcoming observational facilities, including Indian observing facilities, the Vera C. Rubin Observatory's Legacy Survey of Space and Time, and the Thirty Meter Telescope.

The primary objective of the conference was to explore the astrophysics of stellar variability and the use of variable stars as tracers of stellar populations and as

distance indicators. The rigorous scientific program, developed by the Scientific Organizing Committee led by Marina Rejkuba [European Southern Observatory], ensured comprehensive coverage of variability-related topics and a diverse range of contributions. The meeting was inaugurated by R. Srianand [Director, IUCAA], and the first scientific session featured a review talk on the Gaia revolution in variability studies delivered by Richard Anderson [EPFL, Switzerland].

The meeting was attended by 40 faculty members, 33 master's and Ph.D. students, and 27 early-career postdoctoral researchers. It provided a valuable opportunity for young Indian researchers to gain a broad overview of this rapidly advancing field while fostering connections between Indian astronomers and the international research community. Participants also actively contributed to education and outreach activities at IUCAA. Róbert Szabó [Director, Konkoly Observatory, Hungary] delivered a public lecture titled "Are We Alone in the Universe?" at the Chandrasekhar Auditorium. During the meeting, a book

titled *Magical Wonders of the Night Sky*—a translated version of a popular astronomy book originally written in Kannada in 1931 by T. M. Patil was launched. The book launch was attended by R. Srianand, Ajit Kembhavi, Annapurni Subramaniam, B. S. Shylaja, and S. M. Kanbur.

As part of professional development activities, Susmita Das, a member of the Local Organizing Committee and co-chair of the International Astronomical Union Junior Member Working Group, organized a Lunch with a Mentor event that facilitated interactions between senior faculty and early-career researchers. In addition, several postdoctoral researchers delivered lectures during an Amateur Astronomers' Workshop organized by IUCAA's SciPoP program on November 28–29, 2025.

The conference was truly international in scope, with participants from 20 countries, including Australia, Belgium, Canada, Chile, the Czech Republic, Egypt, France, Germany, Hungary, Israel, Italy, Latvia, Poland, South Africa, Spain, Switzerland, the United Kingdom, and the United States of America.

The 10th Indo-French Astronomy School (IFAS-10)



The 10th Indo-French Astronomy School (IFAS-10) was held from November 3–10, 2025 at IUCAA. The school was jointly organized by Kanak Saha [IUCAA] and

Jens-Kristian Krogager [CRAL], with Kanak Saha serving as the IUCAA Coordinator. IFAS-10 marked the tenth edition of this prestigious series, which is co-organized

by the Centre de Recherche Astrophysique de Lyon [CRAL], Lyon, France, and the Inter-University Centre for Astronomy and Astrophysics [IUCAA], Pune, India. The

school is conducted alternately in France and India, a model that strengthens international collaboration and promotes meaningful cultural exchange among participants.

IFAS-10 brought together 28 participants, including early-career Ph.D. scholars, postdoctoral researchers, and a few Master's students from India and several other countries, namely the United Kingdom, Estonia, Brazil, France, Uganda, and Ethiopia. The school focused on the theme "Spectroscopy and Spectrographs," with particular emphasis on observational astronomy using 3D integral-field spectroscopy. The objective was to provide participants with advanced theoretical and practical knowledge in spectroscopy and dynamical modelling, while engaging them in an intensive, week-long research project.

The format of the school was deliberately project-intensive. Lectures were conducted during the morning sessions, while afternoons were dedicated to supervised research work in small groups.

Participants were divided into five project groups, each guided by expert tutors. On the final day, each group presented its findings, with several projects producing promising and insightful results that opened new scientific perspectives.

The lecture program covered a comprehensive range of topics, beginning with an introduction to spectroscopy and extending to advanced observational preparation, integral-field spectroscopy, data reduction techniques, galaxy dynamics in the IFU era, ionizing spectral shapes of galaxies, and Lyman-alpha radiative transfer in IFS data. The lectures were delivered by distinguished scientists from IUCAA, CRAL, and other leading institutions in Europe and India, ensuring a high academic standard throughout the program.

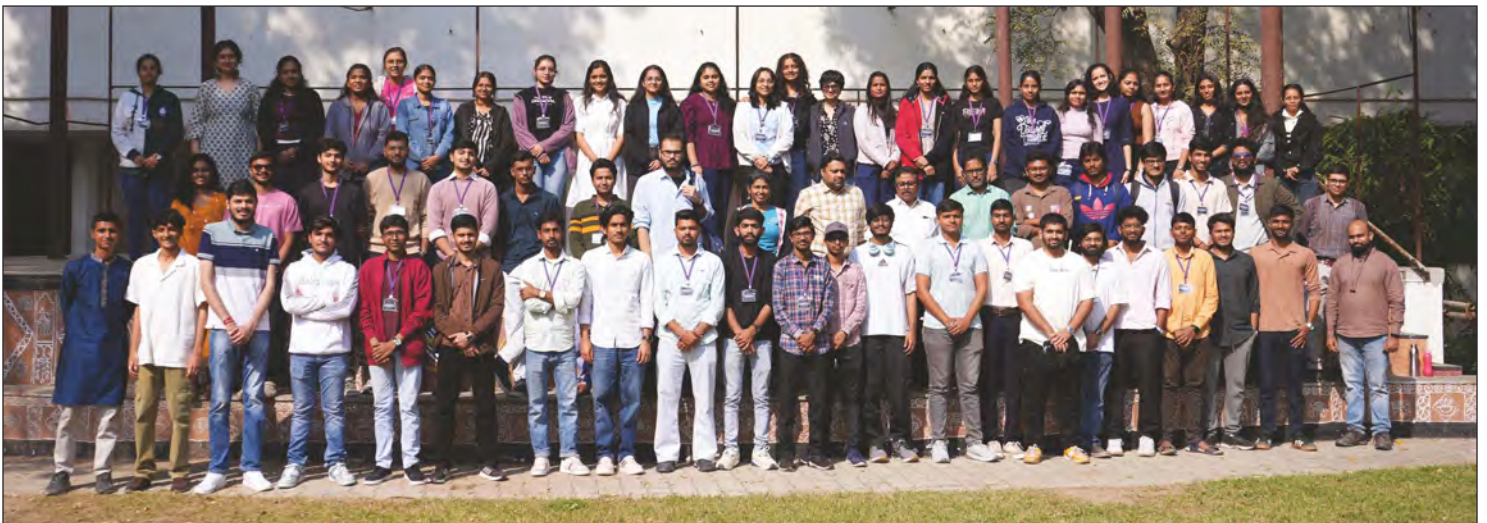
The hallmark features of the IFAS series high-level morning lectures, substantial time devoted to research projects, and diverse international participation were clearly evident in IFAS-10. The collaborative environment enabled

students from India, Europe, and other countries to work closely together, thereby fostering both scientific exchange and cross-cultural interaction. All participants were provided with full boarding and lodging at the IUCAA Guest House, ensuring a comfortable and focused academic environment.

Over the years, the IFAS series has developed a strong reputation for academic excellence and smooth organization. On the concluding day of IFAS-10, a live feedback session was conducted in the presence of all lecturers and participants. The feedback was overwhelmingly positive, with most students expressing high satisfaction with the structure, content, and hands-on research experience offered by the school. Notably, several participants chose to continue their project work even after the formal conclusion of the program. The suggestions and feedback received during the session will be carefully considered to further enhance the next edition, IFAS-11, which is scheduled to be held in Lyon, France, during October–November 2026.

Events outside IUCAA

Hands-On Workshop on Multi-Messenger Astronomy (HWMMA 2025) at St. Xavier's College (Autonomous), Ahmedabad



The Hands-On Workshop on Multi-Messenger Astronomy (HWMMA 2025) was successfully organized at St. Xavier's College (Autonomous), Ahmedabad, from

December 27–30, 2025, under the aegis of the IUCAA Centre for Astronomy Research and Development (ICARD). The workshop was coordinated by *Gurudatt Gaur* (St.

Xavier's College] and *Anupreeta More* [IUCAA]. The four-day workshop was conceived as an intensive training programme aimed at introducing students

and early-career researchers to the rapidly emerging field of multi-messenger astronomy, which integrates observations from gravitational waves, electromagnetic radiation, neutrinos, and cosmic rays to probe astrophysical sources and fundamental physics.

The primary objective of the workshop was to provide participants with a strong conceptual foundation along with hands-on exposure to modern observational and data-analysis techniques used in contemporary astronomy. The academic programme was carefully structured to balance pedagogical lectures with guided practical sessions, enabling participants to engage directly with real and simulated datasets. Emphasis was placed on developing familiarity with publicly available astronomical data archives, standard analysis pipelines, and the interpretation of results within a broader astrophysical context.

The workshop attracted more than sixty participants from over thirty institutions

across India. The participants included senior undergraduate students, postgraduate students, and a small number of doctoral researchers. This diverse academic composition contributed to lively discussions and facilitated peer learning, thereby enriching the overall academic atmosphere of the workshop.

The scientific sessions were delivered by an eminent group of speakers and resource persons from leading research institutions in India. Lectures and hands-on modules were conducted by Tarun Souradeep [Director, RRI], Yashwant Gupta [Director, NCRA-TIFR], Anupreeta More [IUCAA], Apratim Ganguly [IUCAA], Santosh Vadawale [PRL], Mithun N. P. S. [PRL], Anand Sengupta [IIT Gandhinagar], Manjari Bagchi [IMSc, Chennai], Rahul Kashyap [IIT Bombay], Vishal Joshi [PRL], Surhud More [IUCAA], Girjesh R. Gupta [PRL Solar Observatory, Udaipur], Ananya Rawat [PRL Solar Observatory, Udaipur], and Anindya Ganguly [IUCAA]. Collectively, the speakers covered a broad spectrum of topics, including gravitational-wave astronomy,

radio and optical observations, solar astronomy, high-energy astrophysics, and data-analysis techniques relevant to multi-messenger studies.

A major highlight of HWMMA 2025 was its strong emphasis on hands-on learning, during which participants actively worked with gravitational-wave event catalogs, multi-wavelength observational data, and basic parameter-estimation techniques under expert guidance. The interactive format encouraged in-depth discussions on practical challenges encountered in real research workflows, while extended interactions with the speakers helped place the technical material in the context of current research frontiers and open problems in astrophysics. Overall, the workshop was academically stimulating and highly successful in achieving its objectives, providing participants with a coherent introduction to multi-messenger astronomy, equipping them with essential practical skills, and fostering academic networking among students and researchers from diverse institutions.

Introductory Workshop on General Relativity and Gravitation (IWGRG 2025) at Aligarh Muslim University



The Department of Mathematics, Aligarh Muslim University [AMU], in association with the Inter-University Centre for Astronomy and Astrophysics [IUCAA], Pune, and with financial support from the

Anusandhan National Research Foundation [ANRF] and the Council of Scientific and Industrial Research [CSIR], organised a three-day National Workshop titled "Introductory Workshop on General

Relativity and Gravitation [IWGRG-2025]" from December 23-25, 2025, at the Department of Mathematics, AMU, Aligarh. The primary objective of the workshop was to provide postgraduate students,

research scholars, and early-career faculty members with a strong conceptual and mathematical foundation in General Relativity and Gravitation, while bridging the gap between classroom learning and contemporary research frontiers. The workshop was inaugurated by Naima Khatoun, Vice-Chancellor, AMU, in the presence of M. Mohsin Khan, Pro Vice-Chancellor, AMU; Sartaj Tabassum, Dean, Faculty of Science, AMU; Asma Ali, Chairperson, Department of Mathematics, AMU; *Apratim Ganguly*, IUCAA, Pune; and *Musavvir Ali*, Coordinator and Organising Secretary of IWGRG 2025. The dignitaries emphasised the significance of General Relativity and Gravitation in modern science and appreciated the initiative taken by the Department to organise a focused national-level academic programme.

A total of 70 participants, including speakers, resource persons, M.Sc. students, Ph.D. scholars, and faculty

members from various universities and research institutions across India, actively attended the workshop. The academic programme comprised twelve expert lectures, two tutorial and discussion sessions, poster interaction sessions, and two memorial lectures in memory of [Late] J. V. Narlikar and [Late] Naresh Dadhich. The sessions covered a broad range of topics, including tensor analysis, Einstein field equations, exact solutions, relativistic cosmology, modified theories of gravity, black hole physics, gravitational lensing, numerical and analytical techniques in General Relativity, and gravitational wave physics and detection.

The resource persons included Zafar Ahsan [AMU], A. H. Hasmani [Sardar Patel University], P. K. Sahoo [BITS Pilani, Hyderabad Campus], Farookh Rahaman [Jadavpur University], Rajesh Kumar [DDU Gorakhpur University], and *Apratim Ganguly* [IUCAA, Pune]. Their lectures were well received and generated lively

discussions on mathematical derivations, physical interpretations, and current research problems in gravitation and cosmology.

The valedictory session was graced by Mohammad Gulrez, former Vice-Chancellor, AMU, as the Chief Guest. He appreciated the Department of Mathematics for maintaining high academic standards and highlighted the importance of Mathematics and Relativity in contemporary science. The workshop concluded successfully with highly positive feedback from participants and resource persons. It significantly strengthened conceptual understanding, encouraged academic networking, and motivated young scholars towards research careers in gravitational physics. The workshop was coordinated by *Musavvir Ali* under the chairmanship of Asma Ali, Chairperson, Department of Mathematics, AMU, in association with *Apratim Ganguly* [IUCAA, Pune].

Conference on Advances in Astrophysics and Cosmology



The Department of Physics, Farook College [Autonomous], Calicut, organised a three-day national-level IUCAA-sponsored Introductory Workshop on Active Galactic Nuclei [AGN] from December 15-17, 2025. The workshop commenced on the December 17, 2025 with a formal inaugural session, beginning with a welcome address by Midhun Shah, Head of the Department of Physics, who highlighted the importance of observational astronomy in modern

research. The programme was formally inaugurated by Ayisha Swapna, Principal of Farook College [Autonomous], followed by opening remarks by Vaidehi S. Paliya [IUCAA], who emphasized the objectives of the workshop and the significance of hands-on learning. The first lecture was delivered by C. S. Stalin [IIA, Bengaluru], who introduced fundamental concepts of observational astronomy, astronomical telescopes, CCD detectors, and calibration

techniques. This was followed by a session by Vaidehi S. Paliya on the structure, classification, and spectral properties of Active Galactic Nuclei. In the afternoon, a hands-on session on Fermi-LAT and gamma-ray data analysis was conducted by Naseef Mohammed, Baheeja, and Vaidehi S. Paliya, providing participants with practical exposure to space-based astronomy tools. The second day began with a lecture by Sunder Sahayanathan

[BARC, Mumbai] on special relativity and its applications in astrophysics, followed by a session by C. S. Stalin on ground-based optical telescopes, photometry, and observational techniques. A follow-up lecture reinforced concepts in special relativity, after which a hands-on session on radio and X-ray analysis of AGN using DS9 and Fermipy was conducted, focusing on jet studies and data interpretation. The

third day commenced with a lecture by Sunder Sahayanathan on the historical development, structure, and jet theories of AGN, followed by a session by Vaidehi S. Paliya on X-ray and gamma-ray observations and high-energy emission mechanisms. A public lecture by C. S. Stalin on “Advances in Indian Astronomy: From Ground-Based Observatories to Space Missions” highlighted India’s progress in

astronomical research, particularly the AstroSat mission. After the lunch break, Vaidehi S. Paliya conducted a session on career prospects in astronomy and astrophysics. The workshop concluded with certificate distribution, presentation of tokens of appreciation to the speakers, a feedback session, and a vote of thanks by Naseef Mohammed, marking the successful completion of the programme.

Introductory Workshop on Astronomy and Astrophysics at Jai Prakash University (JPU), Chapra



The Department of Physics, Jai Prakash University (JPU), Chapra, in collaboration with the Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune, successfully organized a two-day Introductory Workshop on Astronomy and Astrophysics from December 5–6, 2025, with sponsorship from IUCAA. The workshop aimed to foster scientific curiosity, strengthen conceptual understanding, and encourage research interest among undergraduate and postgraduate students in Bihar. Being the first programme of its kind at Jai Prakash University, it provided a unique platform for students to gain exposure to both foundational concepts and current research trends in astronomy and astrophysics. The workshop was coordinated by *Gulab Chand Dewangan* [IUCAA] and *Kavita Kumari* [JPU].

The workshop recorded the participation of 46 officially registered students from different universities and institutes across Bihar, along with several additional

students from other departments of JPU who attended the sessions. This reflected strong interdisciplinary and inter-institutional interest. The academic sessions were designed to provide both foundational knowledge and exposure to current research areas in astronomy and astrophysics.

The programme was inaugurated in the presence of Parmendra Kumar Bajpai, Vice-Chancellor of Jai Prakash University. The inaugural session was chaired by Gunsagar Yadav, Head of the Department of Physics, JPU. The Chief Guest was Gulab Chand Dewangan, Senior Professor at IUCAA, Pune, an eminent astrophysicist, who also delivered expert lectures and interacted extensively with the participants. In his inaugural address, Gulab Chand Dewangan emphasized the importance of scientific research, advanced observational facilities, and interdisciplinary learning, inspiring students to pursue research careers at both national and international levels.

Day 1 of the workshop focused on fundamental and observational aspects of astrophysics. The first lecture, “High Energy Sky & Experimental Tools”, delivered by Gulab Chand Dewangan, introduced students to high-energy astrophysical phenomena and the experimental tools used in X-ray and gamma-ray astronomy. This was followed by “Stellar Life Cycles: How Stars Are Born, Live, and Die” by Kavita Kumari, Assistant Professor, JPU, which explained the formation, evolution, and end stages of stars in an engaging manner. The final lecture of the day, “Unveiling Our Nearest Star: Introduction to Solar Physics”, delivered by Alok Ranjan Tiwary, Assistant Professor, JPU, focused on the structure, dynamics, and activity of the Sun and its relevance to understanding stellar physics.

Day 2 addressed broader and interdisciplinary themes in astronomy and space science. The first session, “Evolution of the Universe: From Big Bang to Solar

System”, delivered by Priti Mishra, Assistant Professor, Patna University provided an overview of the origin and large-scale evolution of the universe leading to the formation of galaxies, stars, and planetary systems. This was followed by “Space Weather Wizards: Understanding Astrophysical Plasmas and Magnetic Storms” by Sanjay Kumar, Assistant Professor, Patna University, highlighting space weather phenomena, plasma processes, and magnetic storms and their impact on Earth and space-based technologies. The final lecture, “AstroSat: Indian Multi-Wavelength Space Mission

and Career Opportunities”, delivered by Gulab Chand Dewangan, introduced participants to India's first dedicated multi-wavelength space observatory, followed by an interactive discussion on higher education, research avenues, and career opportunities in astronomy and astrophysics.

The workshop concluded with a valedictory session, during which certificates of participation were distributed to all officially registered participants and speakers. The organizers expressed sincere gratitude to the Chief Guest,

chairperson, speakers, university administration, faculty members, and students for their valuable support and cooperation.

Overall, the workshop played a pivotal role in strengthening the research culture at Jai Prakash University and inspired students to explore astronomy and astrophysics as promising fields for higher education and scientific research. The successful organization of the workshop also received coverage in leading local newspapers, highlighting its academic significance and positive impact.

High Energy Astrophysics Workshop at GLA University Mathura



The ICARD, GLA University, Mathura, in collaboration with the Centre for Cosmology, Astrophysics, and Space Science, GLA University, organized a three-day High Energy Astrophysics Workshop (HEAW-2025) from November 18–20, 2025, with support from the Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune. The workshop was coordinated by Vaidehi S. Paliya (IUCAA), Ashutosh Singh, and D. C. Maurya (GLA University, Mathura) and provided a valuable platform for undergraduate and postgraduate students in physics, as well as Ph.D. scholars working in astrophysics and its applications. A total of 35 participants, including 19 men and 16 women, attended the workshop, representing states such as Haryana,

Punjab, Rajasthan, Himachal Pradesh, New Delhi, Madhya Pradesh, and Uttar Pradesh. The workshop was coordinated by Ashutosh Singh (GLA), Dinesh Maurya (GLA), and Vaidehi Paliya (IUCAA).

The workshop commenced with an inaugural ceremony attended by Anup Kumar Gupta, Vice-Chancellor of GLA University, who highlighted the relevance of high-energy astrophysics and encouraged participants to pursue careers in astronomy and astrophysics. The ceremony was also attended by Pankaj Kushwaha and Gunjan Tomar from IISER Mohali, Anirudh Pradhan, members of the Local Organizing Committee, and other faculty members of GLA University.

Over the course of three days, the workshop featured lectures and hands-on sessions delivered by Pankaj Kushwaha (IISER Mohali), Vaidehi S. Paliya (IUCAA), Chetana Jain (Hansraj College, University of Delhi), Dharm Veer Singh (GLA University), Akash Garg (IUCAA), and Gunjan Tomar (IISER Mohali). On the first day, Kushwaha and Singh introduced participants to the fundamental concepts of active galactic nuclei and black holes, while Gunjan Tomar conducted a hands-on session on gamma-ray data analysis using Fermipy, sparking keen interest among participants in the physical aspects and observational computations of gamma-ray astrophysics.

The second day focused on X-ray

astronomy, with Chetana Jain and Akash Garg delivering lectures on “Frontiers in X-ray Astronomy” and “Dissecting the X-ray Universe: Approaches to Data Analysis.” Akash Garg also led a practical session on X-ray data analysis, engaging participants in learning the tools and methods necessary for interpreting astronomical data.

On the final day, Pankaj Kushwaha presented a lecture on “Astronomical Techniques and Instruments,” and Vaidehi S. Paliya introduced gamma-ray astronomy, emphasizing the importance of gamma-ray sources and observational strategies. She also guided participants on career prospects in astronomy and astrophysics, providing insights for those

planning to pursue research in the field. The workshop concluded with the distribution of certificates to all participants, followed by a group photograph, with feedback indicating that most participants were inspired to continue their pursuit of careers in astronomy and astrophysics.

Signal and Image Processing with Machine Learning Applications in Astronomy and Astrophysics at Kannur University



Three-Day Workshop on Signal and Image Processing with Machine Learning Applications in Astronomy & Astrophysics at the Department of Information Technology, Kannur University

The Department of Information Technology, Kannur University, in collaboration with the IUCAA Centre for Astronomy Research and Development (ICARD) and the Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune, organised a three-day workshop on “Signal and Image Processing with Machine Learning Applications in Astronomy & Astrophysics” from November 16 to 18, 2025. The workshop was designed to provide students, research scholars, and faculty members with exposure to modern computational techniques used in astronomical data analysis, with particular emphasis on machine learning and signal processing

methods. The workshop was coordinated by R K Sunil Kumar [Kannur University] and Kanak Saha [IUCAA].

The programme commenced with an inaugural session in which Abdul Haleem P. P., Associate Professor and Head, Department of Information Technology, Kannur University, delivered the welcome address and highlighted the importance of interdisciplinary initiatives in emerging research domains. N. S. Sreekanth, Associate Professor, introduced the academic and research activities of the Department of Information Technology. The workshop was formally inaugurated by Joby K. Jose, Registrar, Kannur University, who emphasised the role of universities in fostering advanced research and institutional collaborations. Rajkumar K. K. felicitated the function, and the vote of thanks was delivered by R. K. Sunil Kumar, ICARD Coordinator and Assistant

Professor, Department of Information Technology, Kannur University.

The technical sessions on Day 1 began with an invited lecture by Kanak Saha, IUCAA, Pune, on “AstroSat UV Deep Field,” which provided valuable insights into India’s AstroSat mission and its scientific contributions to ultraviolet astronomy. The post-lunch sessions were devoted to hands-on training in machine learning using astronomical datasets, conducted by Shilesh Sivan, CUSAT, Kochi. These sessions focused on data preprocessing, feature extraction, and the practical implementation of machine learning workflows using real astronomical observations.

Day 2 of the workshop focused on advanced machine learning techniques in astronomy. Ajit Kembhavi, Emeritus Professor, IUCAA, Pune, delivered lectures

on “Machine Learning in Astronomy,” discussing its evolution, key applications, and future directions. This was followed by a specialised lecture by Ninan Sajeeth Philip, Visiting Professor, IUCAA, Pune, on “Difference Boosting Bayesian Neural Network: A 5D Complex Tensor Formalism,” introducing participants to Bayesian deep learning frameworks and uncertainty-aware modelling. The day concluded with a lecture by Sheelu Abraham, Visiting Associate, IUCAA, Pune, on deep learning approaches for galactic morphological analysis. An evening sky-watch

programme at Astro Payyannur provided participants with hands-on exposure to telescope-based observations and planetarium demonstrations.

The final day featured sessions on astronomical instrumentation and signal processing. N. S. Sreekanth demonstrated a star-gazing device, followed by lectures by R. K. Sunil Kumar on “Signal Processing in Astronomy,” covering time-series analysis, noise modelling, and filtering techniques relevant to observational astronomy. The workshop concluded with a

valedictory session presided over by Anoop Kesavan, Director, IQAC, Kannur University, during which certificates were distributed to the participants.

The workshop successfully enhanced participants' understanding of machine learning and signal processing applications in astronomy, promoted interdisciplinary learning, and strengthened academic collaboration between Kannur University and IUCAA.

J. V. Narlikar Memorial Conference on Cosmology and Astrophysics at Visva-Bharati, Santiniketan



The ICARD, Department of Physics, Visva-Bharati, in association with the Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune, organised the J. V. Narlikar Memorial Conference on Cosmology and Astrophysics [JVNMC 2025] during November 3-4, 2025 at Visva-Bharati. The conference was held jointly in collaboration with three ICARD centres, namely North Bengal University, Cooch Behar Panchanan Barma University, and Malda College. The event was organised to honour the scientific legacy of Jayant Vishnu Narlikar and to discuss recent developments in cosmology and astrophysics. The conference was coordinated by Sudipta Das [Visva-Bharati] and Dipanjan Mukherjee [IUCAA].

A total of eighty-five participants from various Indian institutions and universities attended the conference, including faculty members, research scholars, postdoctoral researchers, and a few M.Sc. students. The conference also hosted two international participants from the University of Warsaw, Poland, and Chulalongkorn University, Thailand.

The inaugural session of the conference was held on November 3, 2025 at the Bangladesh Bhavana Seminar Hall of Visva-Bharati. The conference featured the J. V. Narlikar Memorial Lecture delivered by Ajit Kembhavi [IUCAA], followed by a commemorative session during which delegates shared their memories of J. V.

Narlikar. In addition to the memorial lecture, six invited lectures were delivered by distinguished speakers: L. Sriramkumar [IIT Madras], Dipanjan Mukherjee [IUCAA], Narayan Banerjee [IISER Kolkata], Soumitra Sengupta [IACS Kolkata], Anjan Ananda Sen [Jamia Millia Islamia, New Delhi], and Koushik Dutta [IISER Kolkata].

In addition to the invited talks, the conference included 26 oral presentations and 16 poster presentations by Ph.D. scholars and postdoctoral researchers. A special highlight of the conference was a colloquium lecture delivered by Debiprasad Duari, former Director of the M. P. Birla Planetarium, Kolkata, titled “JVN: The Man with a Mission.” The talk provided deep

insights into J. V. Narlikar's scientific vision, his role in shaping modern cosmology in India, and his lifelong commitment to the popularisation of science. The colloquium lecture was attended by nearly 250 schoolchildren and university students of Visva-Bharati.

The conference sessions facilitated active participation by young researchers and provided a platform for researchers, faculty members, and students to discuss recent developments and emerging

challenges in gravitation, cosmology, and astrophysics. The talks covered a wide range of topics, including dark energy, modified gravity, cosmic structure formation, observational cosmology, and astrophysical processes. Interactive sessions and open discussions further enriched the academic atmosphere of the event.

The co-organisers of the event, Dipanjan Mukherjee [IUCAA Co-coordinator], Tanmoy Paul [Co-convenor], B. C. Paul

[North Bengal University], Ranjan Sharma [Cooch Behar Panchanan Barma University], and Shyam Das [Malda College], jointly expressed their satisfaction with the successful organisation of the conference. Overall, the event was well received by participants and successfully achieved its objectives of honouring Narlikar's legacy, promoting academic exchange, and inspiring the next generation of researchers in cosmology and astrophysics.

Physics of Stars for Undergraduate Instructors: Concepts, Tools, and Pedagogy at Central University of Tamil Nadu, Thiruvarur



A workshop titled "Physics of Stars for Undergraduate Instructors: Concepts, Tools, and Pedagogy" was conducted at the Department of Physics, Central University of Tamil Nadu [CUTN], Thiruvarur, from October 13 to 18, 2025. The event was inaugurated by the Vice-Chancellor of the University, M. Krishnan, in the presence of R. Srianand, Director, IUCAA; P. Ravindran, Dean and Head of the Department; R. Thirumurugan, Registrar of the University; and the invited resource persons. The workshop was coordinated by V. Madhurima and Sampurn Anand [CUTN] | R. Srianand [IUCAA].

This was the first event of its kind organised by CUTN specifically aimed at undergraduate instructors. As the lectures were delivered at the pedagogical level, in addition to teachers, several students from CUTN also attended the programme. R. Srianand delivered lectures on observational astronomy, T. R. Seshadri and Sampurn Anand covered various topics in stellar physics, and V. Madhurima introduced concepts in molecular astrophysics. In addition to the lectures, hands-on training in AstroPy was conducted by Sampurn Anand, providing participants with practical exposure to astronomical data analysis tools.

During the event, R. Srianand interacted with the participating teachers and discussed opportunities available for faculty at IUCAA. He also delivered a special lecture aimed at students from various science departments on "Career Opportunities in Astronomy and Astrophysics."

The workshop received very positive feedback from the nearly 60 participants and was appreciated for its academic depth, pedagogical focus, and practical orientation.

Five-Day Workshop on “Celestial Mechanics and Dynamical Astronomy at IIT (ISM) Dhanbad



A five-day workshop on “Celestial Mechanics and Dynamical Astronomy” was organized by IIT (ISM) Dhanbad from October 13-17, 2025 at the EDC Smart Classroom (EPIROC-II), IIT (ISM) Dhanbad. The workshop was coordinated by *Badam Singh Kushvah* (IIT, ISM), *Anurag Jayswal* (IIT, ISM), with *Kanak Saha* (IUCAA) serving as the IUCAA Coordinator. The program received financial support from ANRF, IUCAA Pune, ISRO, and CSIR.

The primary objective of the workshop was to provide foundational training in celestial mechanics and modern astronomical tools, such as the General Mission Analysis Tool (GMAT), enabling participants to explore realistic models in science and engineering. The workshop aimed to familiarize participants with state-of-the-art research in astrodynamics and astrophysics in India through a combination of lectures and hands-on sessions.

A total of 37 participants registered, of

whom 33 actively attended, representing institutions across India, including Aligarh Muslim University, Central University of Rajasthan, Manipal University Jaipur, University of Delhi, IISER Kolkata, MNIT Allahabad, Fergusson College Pune, and others.

The workshop covered a wide range of topics, including orbital perturbations, Milky Way dynamics using Gaia data, lunar soft landing, exoplanetary orbits, Poincaré maps, low-energy and low-thrust trajectory design, artificial intelligence for periodic orbit discovery, and orbital resonances. Hands-on laboratory sessions were conducted using Python and GMAT.

The program featured eminent resource persons from India and abroad, including experts from IISc Bangalore, ISRO, IUCAA, BITS Pilani, IIST, Kyushu University (Japan), University of Strathclyde (UK), and the University of Rome Tor Vergata. Teaching assistants and volunteers provided technical and academic support

throughout the workshop.

The workshop was well received by participants and successfully met its objective of strengthening conceptual understanding and practical skills in celestial mechanics and dynamical astronomy.

Workshop on Astrophysics and Cosmology at Bharata Mata College, Kochi



The IUCAA-sponsored Workshop on Astrophysics and Cosmology was successfully conducted on October 9–10, 2025, with the objective of introducing students and teachers to contemporary developments in astrophysics and cosmology. The workshop was organised by ICARD – Bharata Mata College, Kochi, in association with the Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune, and was coordinated by *Manesh Michael* (Bharata Mata College) and *Surhud S. More* (IUCAA).

The workshop also served as a tribute to the illustrious astrophysicist Jayant Narlikar, whose pioneering contributions have shaped modern cosmological research in India and worldwide. The programme brought together eminent researchers from IUCAA and leading institutions, providing participants with valuable exposure to both foundational concepts and frontier areas of research such as gravitational waves and gravitational lensing.

The inaugural ceremony commenced on October 9, 2025, with a welcome address by Manesh Michael, ICARD Coordinator. Sebastian Kallungal, Assistant Director of Bharata Mata College, delivered the inaugural address, emphasising the importance of scientific temper, research culture, and academic collaboration with premier research institutions such as IUCAA. A special homage to Jayant Narlikar was delivered by Titus K. Mathew (CUSAT), who highlighted Narlikar's seminal contributions to cosmology, his role in institution-building, and his enduring influence on generations of students and researchers. The inaugural session was further enriched by felicitations from Surhud S. More (IUCAA). The session concluded with a vote of thanks by Shibi Thomas, Head of the Department of Physics, Bharata Mata College, who expressed sincere gratitude to IUCAA, the invited speakers, organisers, and participants for their enthusiastic involvement. The dignified and well-structured inaugural programme set an inspiring tone for the scientific

deliberations that followed.

The first technical session featured a lecture by Surhud S. More (IUCAA) on “Introduction to Cosmology.” The talk provided a comprehensive overview of the fundamental principles of cosmology, observational evidence for the expanding universe, and recent advances in the field. In the second session, Titus K. Mathew delivered an insightful lecture on “Emergence of Space and the Cosmological Constant.” The talk addressed deep conceptual issues related to the nature of space, dark energy, and the cosmological constant, offering participants perspectives on ongoing theoretical challenges.

Post-lunch, Haris M. K. (NIT Calicut) presented a stimulating lecture titled “Beyond Light: The Era of Gravitational Wave Astronomy.” The session highlighted the detection of gravitational waves, their astrophysical sources, and their significance in opening a new observational window to the universe. The

final session of Day 1 was conducted by Surhud S. More [IUCAA] on “Introduction to Gravitational Lensing,” focusing on the physical principles of gravitational lensing and its applications in probing dark matter and large-scale structure in the universe.

The second day of the workshop continued with focused sessions aimed at exposing participants to high-energy astrophysics, observational techniques, and career pathways in astronomy. The day commenced with a lecture by Vaidehi S. Paliya [IUCAA] titled “An Introduction to Gamma-ray Astronomy,” which introduced participants to high-energy processes in

the universe and the role of gamma-ray observations in understanding extreme astrophysical phenomena. Vinu Vikraman [Central University of Kerala] delivered an informative lecture on “Weak Lensing Overview,” highlighting weak gravitational lensing as a powerful tool for studying dark matter distribution and the large-scale structure of the cosmic web.

In the concluding technical session, Vaidehi S. Paliya [IUCAA] conducted an engaging and practical talk on “Career Prospects in Astronomy.” The session provided valuable guidance on academic pathways, research opportunities, and

career options in astronomy and astrophysics, motivating students to pursue higher studies and research in the field.

A feedback session was held towards the end of the programme, during which participants shared their impressions, learning experiences, and constructive suggestions. The workshop concluded with a valedictory session, formally marking the successful completion of the two-day IUCAA-sponsored Workshop on Astrophysics and Cosmology.

Workshop on Data Analytics and AI in Physics and Astronomy at the University of Kashmir, Srinagar



The IUCAA Centre for Astronomy Research and Development [ICARD], Department of Physics, University of Kashmir, in association with the Inter-University Centre for Astronomy and Astrophysics [IUCAA], organized a four-day workshop on *Data Analytics and AI in Physics and Astronomy* from October 7–10, 2025, at the University of Kashmir, Srinagar. The primary objective of the workshop was to introduce science students and young faculty members to data analytics and artificial intelligence, with special emphasis on applications in physics and astronomy.

Around 50 participants, including M.Sc. [Science] students, Ph.D. scholars, and faculty members, actively attended the workshop. Four resource persons from IUCAA and associated institutions Ajit Kembhavi [IUCAA], Yogesh Wadadkar [NCRA], Sajeeth Philip [AIRIS, Kerala], and Aseem Paranjape [IUCAA] delivered lectures covering a wide range of topics. These included machine learning fundamentals, convolutional neural networks [CNNs], autoencoders, astronomical data analysis, AI applications in astronomy, probability theory, Bayesian statistics and Bayesian machine learning

models, Markov Chain Monte Carlo [MCMC] theory, as well as basic and advanced generative AI codes for astronomy. The workshop also featured a popular lecture titled “Galaxies at the Dawn of Time with JWST.”

The sessions were well received, as reflected in the positive feedback from participants. The workshop was coordinated by Ajit Kembhavi [IUCAA] and Manzoor A. Malik [University of Kashmir].

North East Meet of Astronomers (NEMA) – XI Edition at Rajiv Gandhi University (RGU), Doimukh, Arunachal Pradesh



The Eleventh Edition of the North East Meet of Astronomers (NEMA-XI) was successfully organized by the Department of Physics, Rajiv Gandhi University (RGU), Doimukh, Arunachal Pradesh, in collaboration with the Inter-University Centre for Astronomy and Astrophysics (IUCAA), Pune, from October 6 to 8, 2025. The event was generously sponsored by IUCAA and aimed to provide a collaborative platform for researchers, teachers, and students from the north-eastern region of India to exchange ideas and strengthen regional scientific networks in astronomy, astrophysics, and allied fields. As a curtain-raiser to the main event, a night-sky stargazing session was organized on the evening of October 5, 2025, drawing enthusiastic participation from 26 students of Dera Natung Government College (DNGC), Itanagar, along with 16 M.Sc. and 12 undergraduate physics students of RGU. The session featured engaging talks by Ranjeev Misra (IUCAA) and Gazi Ameen Ahmed (Tezpur University), who highlighted the wonders of the cosmos and emphasized the importance of nurturing scientific curiosity among young learners.

The inaugural session on October 6, 2025, began with a welcome address by P. K.

Kalita [Department of Physics, RGU]. The event was formally inaugurated by S. K. Nayak, Vice-Chancellor, RGU, who underscored the importance of NEMA as a platform for fostering scientific collaboration across the north-eastern region. Tenzing Norbu Thongdok, Member of the North Eastern Council (NEC), Shillong, appreciated regional efforts to strengthen science education and reiterated NEC's commitment to supporting space science initiatives. Ranjeev Misra and Kanak Saha (IUCAA) highlighted IUCAA's outreach and capacity-building programmes, emphasizing the value of sustained engagement with universities and institutions in the region. Sanjeev Kumar, Dean of Basic Sciences, delivered an insightful lecture titled "Faith and Fact in Astronomy and Astrophysics."

Out of 97 registered applicants, 72 participants were selected for the meet. The academic programme comprised 10 invited talks (mostly by IUCAA associates), 30 contributory talks by research scholars and faculty members, and three flash talks by M.Sc. students and first- to third-year research scholars. The sessions were marked by in-depth discussions that significantly enhanced scientific

interaction and collaboration. On the third day, an open "walk-in presentation" session encouraged spontaneous participation and led to several productive exchanges of ideas.

The event concluded on October 8, 2025, with an open feedback session, during which participants expressed appreciation for the academic depth of the programme and its effectiveness in fostering scientific dialogue and potential future collaborations. The Eleventh Edition of NEMA was jointly coordinated by Kanak Saha (IUCAA) and Heisnam Shanjit Singh [Department of Physics, RGU].

Workshop on Solar and Stellar Physics at Dolphin PG College and Doon University, Uttarakhand



The Workshop on Stellar and Solar Physics, jointly organized by the Dolphin PG Institute of Biomedical and Natural Sciences [DIBNS] and Doon University and sponsored by IUCAA, Pune, was held from October 6–8, 2025. The three-day academic event brought together 50 participants, including 20 students from remote hilly regions of Uttarakhand, offering them valuable exposure to advanced concepts in astronomy and astrophysics.

The workshop commenced at DIBNS with a welcome address by Shailja Pant, followed by an inaugural address by Deepak Kumar Gairola, Secretary, Sanskrit Education, Government of Uttarakhand. He eloquently linked India's ancient astronomical heritage with modern astrophysics and encouraged students to view the sky as a laboratory for scientific exploration. The inaugural session was further enriched by the presence of distinguished academicians, including Hemwati Nandan, Himani Sharma, Gyanendra Awasthi, Shruti Sharma, and Kuldeep Rawat. Aasheesh Raturi, the Organizing Secretary, outlined the vision of the workshop and highlighted its alignment with the National Education Policy 2020, emphasizing interdisciplinary learning and astronomy outreach across Uttarakhand.

The first day focused on the fundamentals of stellar physics. Anupam Bhardwaj [IUCAA] introduced participants to solar and stellar astronomy, followed by an engaging lecture on star formation by Saurabh Sharma [ARIES]. Subsequent sessions covered stellar evolution, observational astronomy using telescopes, and compact objects such as neutron stars and black holes, presented by Anupam Bhardwaj, Virendra Yadav, and Balendra Pratap [UPES], respectively. The day concluded with a hands-on telescope observation session guided by Kaushal Sharma, Virendra Yadav, and Anupam Bhardwaj, during which many students experienced telescopic observations for the first time.

The second day was devoted to solar physics and the integration of machine learning into astronomy. Durgesh Tripathi [IUCAA] delivered in-depth lectures on solar phenomena, including sunspots, magnetic fields, helioseismology, and photon transport from the solar core to the surface. This was followed by sessions on multiwavelength observations of star formation, stellar pulsations, and practical demonstrations of machine learning applications in astronomical data analysis by Saurabh Sharma, Anupam Bhardwaj, and Kaushal Sharma, respectively.

Aasheesh Raturi also presented the “Stars Over Hills” outreach initiative, highlighting efforts to promote astronomy education in remote mountainous regions and facilitate student participation in the workshop.

The final day was held at Doon University, where participants were welcomed by Himani Sharma, who encouraged the use of artificial intelligence and machine learning in future astronomical research. Durgesh Tripathi presented a detailed lecture on India's Aditya-L1 solar mission, explaining the significance of the L1 Lagrange point and its scientific objectives. Further talks covered recent advances in star formation studies across multiple wavelengths, the role of stars in understanding the evolution of the universe, and various methods of exoplanet detection, delivered by Saurabh Sharma, Anupam Bhardwaj, and Kaushal Sharma.

The workshop concluded with a feedback session in which participants expressed strong appreciation for the academic depth, clarity of lectures, and hands-on experiences. Feedback indicated overwhelmingly positive responses, and certificates were distributed to all participants. Overall, the IUCAA-sponsored Workshop on Stellar and Solar Physics

proved to be a transformative and inspiring experience, particularly for students from Uttarakhand's remote hilly regions. The event successfully blended theoretical learning with practical observation,

strengthened institutional collaborations, and fostered lasting enthusiasm for astronomy and astrophysics. The workshop was coordinated by *Aasheesh Raturi* [Dolphin Institute], *Himani Sharma*

[Doon University], and *Anupam Bhardwaj* [IUCAA].

Welcome to...

IUCAA welcomes **Sayantani Datta**, **Akash Garg**, **Sarang Shashikant Shah**, and **Abhijeet Anand**, who have joined IUCAA as Post-Doctoral Fellows.

Farewell to...

We bid farewell to **Subhashree Swain**, who has completed her tenure at IUCAA as a Post-Doctoral Fellow.

We also bid farewell to **Payel Nandi** and **Soumil Maulick**, who have resigned from IUCAA as a Post-Doctoral Fellow and a Senior Research Scholar, respectively.

Colloquium

31.10.2025 Dr. R. Vijayaraghavan on **Observing quantum effects in a “macroscopic” electrical circuit**

Seminars

14.10.2025 Dr. Swagat Mishra on **Phantom Divide Crossing of Dark Energy on the Braneworld in light of DESI DR2**

16.10.2025 Dr. Sujay Mate on **Present and future of X-/gamma-ray polarimetry in India**

04.11.2025 Prof. Teruaki Suyama on **Applications of Kramers–Kronig Relations to Gravitational-Wave Lensing**

06.11.2025 Dr. Niranjan Myneni on **From Emulating Quantum Phenomena to Precision Quantum Sensing with Ultracold Atoms**

18.11.2025 Mr. Saurabh on **Probing horizon scale magnetic fields and strong-field gravity with polarized EHT observations of M87***

02.12.2025 Mr. Nihar Gupte on **Fast Inference of Gravitational Waves Enable Discoveries about Compact Objects**

04.12.2025 Dr. Vigneshwaran Krishnamurthy on **Atmospheric Escape in the Era of JWST**

09.12.2025 Prof. T. P. Singh on **Why do elementary particles have such strange mass ratios?**

11.12.2025 Dr. Payel Nandi on **The Multiphase Impact of AGN Outflows: From Parsecs to Galactic Scales**

16.12.2025 Sayali Avachat on **Book Publishing Program at Springer and Publishing Opportunities**

18.12.2025 Dr. Francesco Di Renzo on **News from the Gravitational-Wave Frontier: Latest Results and Insights from the LVK O4 Observing Run and GWTC-4**

Awards & Recognitions (January–December 2025)

Congratulations to...

- **Anupam Bhardwaj** on receiving the **Prof. M. K. Vainu Bappu Gold Medal for the year 2024** from the Astronomical Society of India, January 2025.
- **Debarati Chatterjee** on being awarded the **George Southgate Fellowship–2025** by the University of Adelaide, Australia, February 2025.
- **Durgesh Tripathi** on receiving the **Distinguished Alumnus Award** from DDU Gorakhpur University, May 2025.
- **R. Srianand** on being elected as a **Fellow of the Indian National Science Academy**, September 2025.
- **Varun Sahni** on being appointed as **National Science Chair** by the Anusandhan National Research Foundation, October 2025.
- **Surhud More** on receiving the **Rashtriya Vigyan Puraskar – Vigyan Yuva (Shanti Swarup Bhatnagar)**, December 2025.
- **Late Jayant V. Narlikar** on being posthumously conferred the **Rashtriya Vigyan Puraskar – Vigyan Ratna**, December 2025.

LIGO-India Education & Public Outreach (LIEPO) Activities

Build-a-Detector Workshop

LIGO-India EPO organised the 2025 Build-a-Detector workshop, in collaboration with the University of Glasgow [UK], from November 10–21, 2025. The workshop introduced students to gravitational wave science and the key considerations involved in designing and conceptually building a gravitational wave detector, as well as the types of signals expected to be measured. A series of lectures covered the main noise budgets and potential astrophysical sources. The final three days of the workshop focused on team-based design of their own gravitational wave detectors, including noise budgets and source plots. The winning team will have the opportunity to present their design at the University of Glasgow.



Exceptional Discovery: GW241011 & GW241110

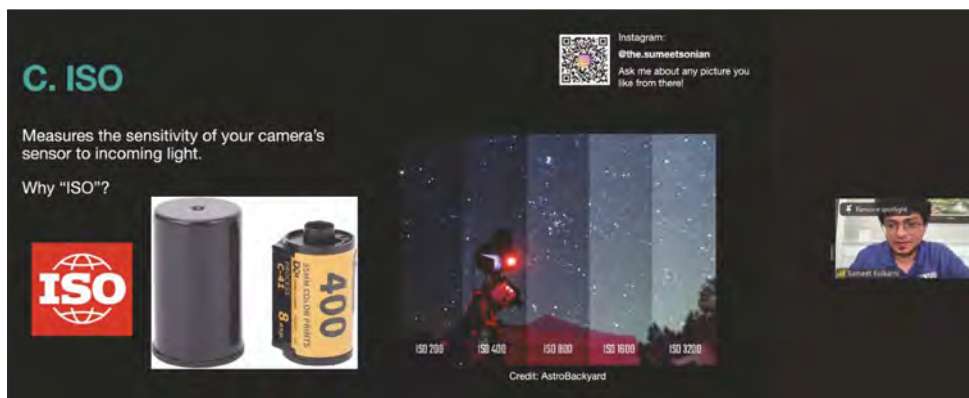
On October 11, 2024 and November 10, 2024, the LIGO–Virgo–KAGRA [LVK] Collaboration detected a pair of distant cosmic black hole mergers. Data collected from these events validated, with unprecedented accuracy, fundamental

laws of physics predicted over 100 years ago by Albert Einstein. LIGO-India EPO coordinated the news release, including an announcement on the LIGO-India website and a pedagogical blog article by Ish Gupta [University of California, Berkeley], a

member of the paper writing team. With the help of infographics created by Shanika Galaudage [Northwestern University], the discovery was communicated to a broader audience through LIGO-India social media platforms.

Astrophotography Webinar (16th Dec) and Contest – Ongoing

To promote astronomy among a broader audience, LIGO-India EPO is organising a series of astrophotography contests and webinars. On December, 16, 2025 astrophysicist and award-winning science communicator Sumeet Kulkarni was invited as the guest speaker to deliver an astrophotography webinar. The session provided participants with valuable insights into the art and science of capturing the night sky, blending technical guidance with creative perspectives. Sumeet Kulkarni's engaging presentation inspired aspiring astrophotographers and astronomy enthusiasts alike, making the webinar an enriching learning experience



and a highlight of the LIGO-India EPO initiative to promote interest in astronomy and space science. The webinar was followed by an Astrophotography contest, and the winning entries were exhibited on National Science Day at IUCAA, Pune.

Film Screening: Bending Light

Screenings of the documentary film *Bending Light* were organised on November 27, 2025 at the Jawaharlal Nehru Planetarium (JNP), Bengaluru, by the Raman Research Institute (RRI), and on November 29, 2025 at the Indian Institute of Technology (IIT) Bombay. The documentary highlights the historic race to test Albert Einstein's General Theory of Relativity during the 1922 expedition.

The film features insights from Archana Pai (IIT Bombay) and Annapurni Subramaniam (Indian Institute of Astrophysics, Bengaluru). The screenings attracted enthusiastic participation from students and researchers, with over 50 participants



at JNP and around 75 participants at IIT Bombay. The events were successful outreach initiatives that fostered interest in gravitational physics and the history of science. The programme was facilitated by LIGO-India Education and Public Outreach (EPO).

IIT Bombay Techfest

LIGO-India Education and Public Outreach participated in IIT Bombay Techfest from December 22-24, 2025, engaging the public by spreading awareness of gravitational wave science through interactive and hands-on exhibits. Visitors explored working models such as a Michelson interferometer, enjoyed the GW photobooth, and learned from informative posters explaining gravitational waves and LIGO science.

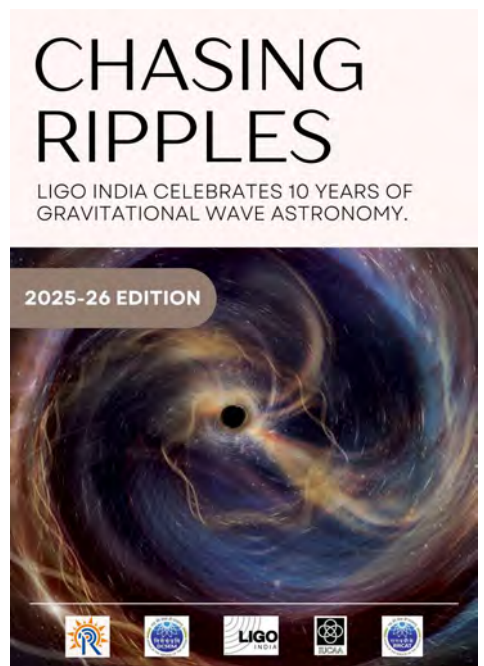
Rahul Kashyap from IIT Bombay, along with LISC member students Yugesh Bhoge, Johann Fernandes, Vasudev Dubey, Nitesh



Jaishwal, Soumya Bhattacharya, and Hari, participated in the event. From LIGO-India EPO, Saurabh Salunkhe and Harsh Satam were also present.

Chasing Ripples (LIGO-India EPO's E-Magazine)

LIGO-India Education and Public Outreach proudly announced its triannual e-magazine, Chasing Ripples, on December 31, 2025 to showcase its diverse activities. The magazine highlights LIGO-India EPO's efforts in communicating and educating the public about gravitational waves and detector science from September to December 2025. The launch also marked the celebration of 10 years of gravitational wave science. The magazine was designed by LIGO-India EPO interns.



Astronomy Centre for Educators Activities

National Education Policy – 2020: Orientation and Sensitization

The Malaviya Mission Teacher Training Centre (MMTTC) of the Astronomy Centre for Educators (ACE) conducted a two-week online capacity-building programme titled "National Education Policy – 2020: Orientation and Sensitization" from October 1-10, 2025. The programme was open to faculty members, research scholars, research associates, post-doctoral fellows, demonstrators, and tutors from higher educational institutions across the country. To be eligible for certification, participants were required to submit two essays based on topics covered during the programme.

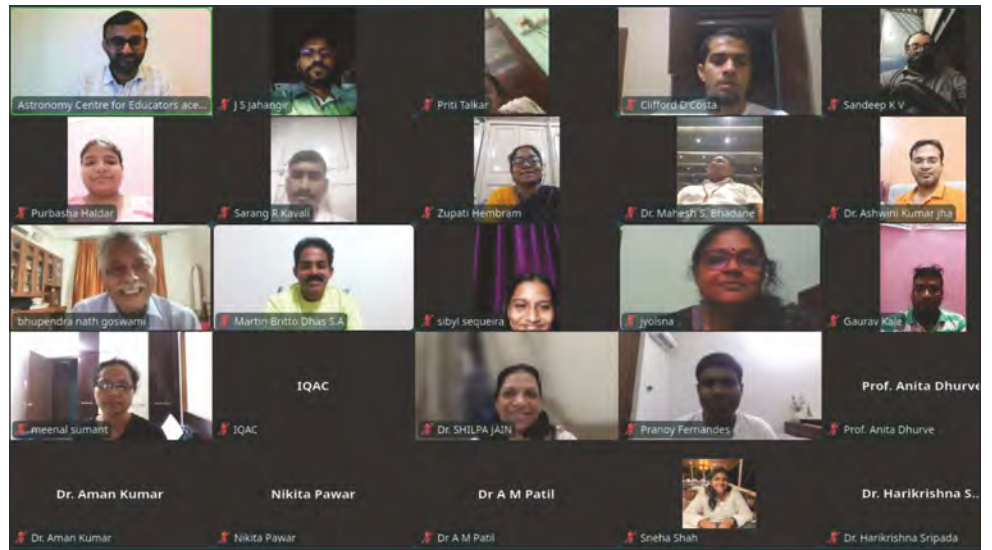
Approximately 30-35 participants attended the sessions each day, and 23 participants successfully completed the requirements and received certificates. The programme comprised two sessions each on eight major themes of the National Education Policy (NEP) 2020, delivered by eminent speakers with extensive experience in their respective fields. The sessions provided comprehensive insights into policy frameworks, pedagogical reforms, governance, inclusivity, and the future of higher education in India.

The themes and speakers for the programme were as follows:

- Holistic and Multidisciplinary Education
Aniket Sule (HBCSE, TIFR) and **Dhruba J. Saikia** (Former Head, ACE, IUCAA)
- Research and Development
Narayan Rangaraj (IIT Bombay) and **Bhupendra Goswami** (Gauhati University)
- Indian Knowledge Systems
Mayank Vahia (Former Professor, Tata Institute of Fundamental Research)
- Skill Development
N. V. Varghese (NIEPA, Sonapat) and **Narayan Sharma** (Cotton University, Assam)
- Student Diversity and Inclusive Education
Ajailiu Niumai (University of Hyderabad) and **Ayush Gupta** (HBCSE, TIFR)
- Higher Education and Society
Dhruba J. Saikia (Former Head, ACE, IUCAA) and **Saumen Chattopadhyay** (Jawaharlal Nehru University)

- Academic Leadership, Governance, and Management
Abdul Shaban (Tata Institute of Social Sciences) and **Garima Malik** (NIEPA)
- Information and Communication Technology
Yogendra Pal (Vivekananda Global University)

The programme was well received by participants, who appreciated the clarity of presentations, depth of discussion, and relevance of the themes to contemporary higher education. Overall, the orientation programme successfully enhanced participants' understanding of NEP 2020 and its implications for teaching, research, governance, and inclusive education practices.



Radio Astronomy Winter School [RAWS-2025]



The 18th edition of the annual Radio Astronomy Winter School (RAWS-2025) was jointly organized by the Inter-University Centre for Astronomy and Astrophysics (IUCAA) and the National Centre for Radio Astrophysics-TIFR (NCRA-TIFR) from December 9-19, 2025. The programme received over 470 applications, from which 11 educators and 26 student participants were selected to attend. The educator category included faculty members, research scholars, postdoctoral fellows, and scientific staff interested in incorporating radio astronomy concepts and experiments into college-level curricula. The student participants were primarily third-year and a few second-year undergraduates, many of whom were being introduced to radio astronomy for the first time.

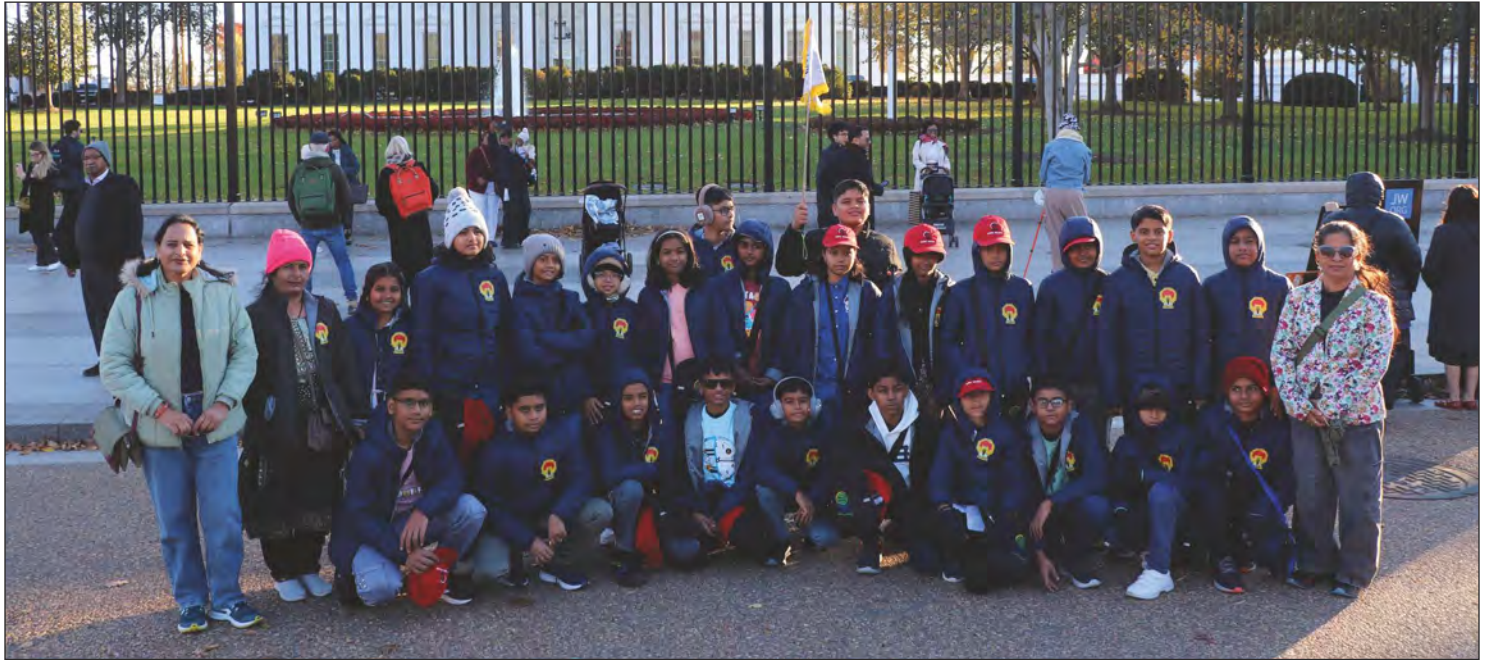
The lecture sessions began with a broad overview of radio astronomy and various radio observation techniques. Subsequent lectures covered topics such as the Sun, radiative processes, cosmology, pulsars and radio transients, active galaxies, and multiwavelength astronomy, emphasizing the critical role of radio observations in understanding these systems. To reinforce the concepts introduced in the lectures, several tutorial sessions were included this year. During the late morning and afternoon sessions, participants worked in groups on hands-on experiments characterizing detector noise, gain, and directionality. They also used a horn antenna to observe the 21-cm neutral hydrogen emission and derive the Galaxy's rotation curve.

One of the major highlights of the school was an overnight visit to the Giant Metrewave Radio Telescope (GMRT), where participants received a guided tour of the observatory's design and operations and observed the Geminids meteor shower during the night. On the final day, each group presented one of their selected experiments, and the students participated in a game-style quiz covering the topics taught during the school.

The enthusiasm and active participation of both students and educators contributed significantly to the success of the programme and made it an engaging and enriching educational experience. The organizing committee comprised Avinash Deshpande, Jameer Manur, Prakash Arumugasamy, and Rajeshwari Dutta (IUCAA), and Subhashis Roy (NCRA-TIFR).

Public Outreach Activities

Special Outreach Programs



IUCAA is conducting a rural educational programme in collaboration with the Zilla Parishad, Pune (ZPP), for underserved rural schools in the district. The two organizations signed an MoU in April 2025 to establish a collaborative framework for conducting awareness and training sessions and organizing exposure visits for students and teachers from ZPP schools.

As a first step, IUCAA selected bright students from Classes 6 and 7 of ZPP schools through educational and inspirational activities, including scientific guidance, workshops, and student screening. IUCAA also facilitated exposure visits to ISRO, NASA, and other educational facilities by developing visit content, framing useful itineraries, and ensuring personal interactions with scientists at these institutions.

The following visits were conducted:

1. A 10-day tour of the USA for 25 students, which included visits to the Indian Embassy, NASA headquarters, and various Smithsonian museums in Washington, D.C.; the Kennedy Space Center in Orlando; and the California Academy of Sciences, Stanford



- University, and Google headquarters in San Francisco. Samir Dhurde served as the academic mentor during the trip.

2. A visit for 50 students to the Thumba Equatorial Rocket Launching Station and the Indian Institute of Space Science and Technology, Thiruvananthapuram, Kerala. Prasad Adekar and Tushar Purohit acted as mentors during the visit.

3. A visit for 50 students to New Delhi, including the Science Centre and Planetarium, as well as a special meeting with the President of India.

Following the selection process, IUCAA also conducted nine teacher workshops for science teachers across all 13 talukas under the ZPP Education Department. Further engagement will continue with the most motivated participants.

IUCAA – Zilla Parishad, Pune Teacher Training Program

On October 7 - 8, 2025 and December 11 and 19, 2025, a total of nine teacher training sessions were organized for teachers from the Bhor, Velhe, Baramati, and Purandar talukas. A total of 112 teachers from ZP Pune schools participated in these workshops.



Rashtriya Kala Mahotsav Students' Visit to IUCAA (Organized by SCERT, Maharashtra)

A total of 150 school students from across India visited the IUCAA campus on 24 December 2025 while attending the Rashtriya Kala Mahotsav in Pune. A special session was organized at IUCAA for these students.



Workshop on Amateur Astronomy Observations of Variable Stars

A two-day workshop on Variable Star Observations for amateur astronomers was organized during November 28-29, 2025 at IUCAA to share technical expertise with 30 selected participants from across the country. The workshop was coordinated by *Samir Dhurde* (IUCAA). Technical talks were delivered by experts from India and abroad. Participants received hands-on experience in data analysis and registering their work with the AAVSO. Observing sessions were conducted at the JVP Kesariwada Observatory and at IUCAA.



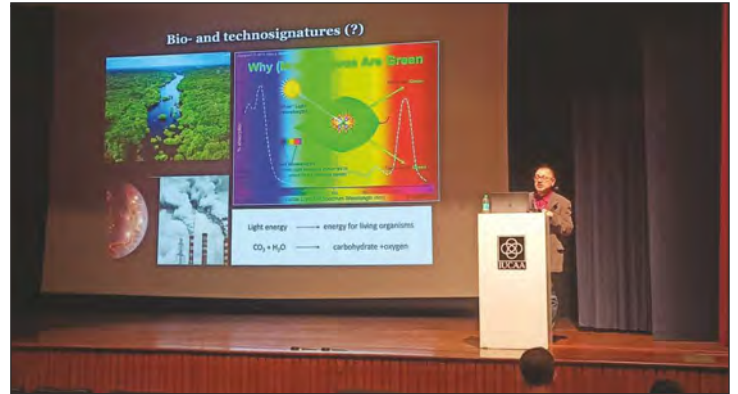
Chandra Public Lectures

Public Lectures

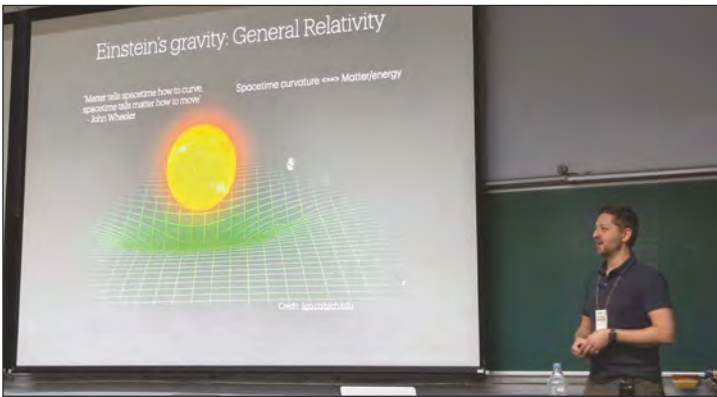
The **Chandra Public Lectures series**, along with other outreach collaborations, brought the following talks to the people of Pune and a wider online audience:



Shasvath Kapadia [IUCAA] delivered a lecture titled *“Gravity & Gravitational Waves: Einstein’s Extraordinary Legacy on October 16, 2025.*



Robert Szabo [Director, Konkoly Observatory] delivered a lecture titled: *“Are We Alone in the Universe on?” on November 27, 2025.*

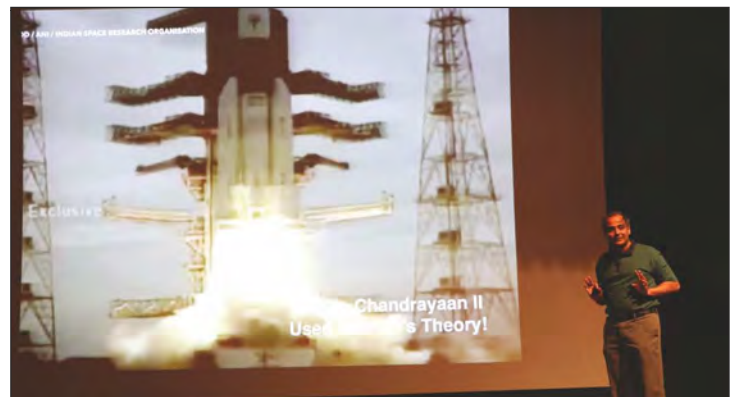


Evan Goetz, [The University of British Columbia] delivered a lecture titled *“Prelude to the Cosmic Symphony – Observations and Challenges in Detecting Gravitational Waves” on December 16, 2025.*

2nd Saturday Lectures



Sudhir Phakatkar [NCRA-TIFR] delivered a lecture titled *“Moon Missions” on October 11, 2025.*



Shasvath Kapadia [IUCAA] delivered a lecture titled *“Gravity & Gravitational Waves: Einstein’s Extraordinary Legacy” on December 13, 2025.*

Regular Workshops, Visits, and Outreach Events

Various outreach activities were conducted during this quarter by members of the IUCAA SciPop team, either as organizers or resource persons.



1. Telescope-Making Workshop, Goa on October 3, 2025. 56 teachers participated.



2. **Workshop for School Students on High Energy Astronomy in India, including spectroscopy (IAPT), Goa University during October 4-5, 2025. 60 students and 10 teachers participated.**



3. Telescope-Making Workshop, University College, Trivandrum (ICARD) on October 7, 2025. 89 teachers participated.

4. **Space Week Talk & Career Guidance Session, St. Joseph University, Chümoukedima, Nagaland on October 17, 2025. 50 students and 10 teachers participated.**



5. Science & Astronomy Session for Kalyani International School on November 6, 2025. 100 students and 15 teachers participated.



6. Science & Astronomy Session for Silver Crest Junior College on November 6, 2025. 100 students and 5 teachers participated.



7. Special Science & Astronomy Workshop for Vidyapeeth High School, Pune, and Rambhau Moze Prashala, Yerwada on November 18, 2025. 43 students and 3 teachers participated.



8. Telescope-Making Workshop at G. P. Birla Science Centre, Hyderabad on November 22, 2025. 70 teachers participated.

9. Science & Astronomy Session at Gendibai Chopada High School, Chinchwad on November 28, 2025. 220 students participated.



10. Science & Astronomy Workshop for Shri Sambhaji Raje Madhyamik Vidyalaya, Jategaon on December 2, 2025. 40 students and 5 teachers participated.

11. Science & Astronomy Talk at Muktadevi Vidyalaya, Narodi on December 3, 2025. 225 students and 9 teachers participated



12. Science & Astronomy Talk for Thakur College of Science, Kandivali on December 3, 2025. 50 college students and 7 teachers participated.

13. Science & Astronomy Session for Late Baburao Joshi Gurukul, Ratnagiri on December 4, 2025. 25 students and 5 teachers participated.



14. Telescope-Making Workshop at Presidency University, Kolkata (ICARD) on December 5, 2025. 70 teachers participated.

15. Science & Astronomy Talk at Vishwakarma Vidyalaya, Bibwewadi on December 17, 2025. 350 students and 36 teachers participated.



16. Science & Astronomy Session for MIT School, Loni Kalbhor on December 18, 2025. 40 students and 5 teachers participated.

17. Telescope-Making Workshop for the LGP-IISER Program on December 20, 2025. 80 students participated.



18. Astronomy and Stargazing Event at C. T. Bora College, Shirur on December 26, 2025. 450 students and members of the public participated.

19. Astronomy and Stargazing Event organized by CSEC, SPPU & IUCAA Scoop on December 29, 2025. - 470 students and members of the public participated.



20. Nagpur Exploratory Students' Visit to IUCAA on December 31, 2025. 25 students participated.

Visitors

[October - December 2025]

Mahdi Abdollahi, Hemani Acharya, Samsuzzaman Afroz, Sabir Ahmed, Shahil Akhtar, Shahzada Akhter, Shadab Alam, Toushif Alam, Heena Ali, Md Sabir Ali, Kewal Anand, Ananya Anandharaman, Rakesh B.R., Rajan Badyal, Ananya Bandopadhyay, Gourav Banerjee, Anurag Baruah, Aru Beri, Manthan Bhagat, Ashvini Bhardwaj, Bhargava Ganesh Bhat, Hitaisi Bhatt, Debadri Bhattacharjee, Snigdha Bhattacharjee, Shatanik Bhattacharya, Suman Bhattacharyya, Sree Bhattacharjee, Shubhagata Bhaumik, Kaushil Dasharath Bhoir, Soumadip Rabindranath Bhowmick, Sougata Bhunia, Gautam Bhuyan, Nigel Bishop, Promila Biswas, Ritabrata Biswas, Chetan Bora, Mary Bosco, Cyril Sabu C., Fazil C.K., Marcio Catelan, Sulagna Chakrabarti, Arghya Chakraborty, Koushik Chakraborty, Subenoy Chakraborty, Subhamoy Chakraborty, Kabir Chakravarti, Nabajit Chakravarty, Monoswini Chakravorty, Tarak Chand, Suresh Chandra, Pradip Kumar Chattopadhyay, Surajit Chattopadhyay, Mayank Chaturvedi, Shivani Chaudhary, Reena Chaudhury, Jaiverdhan Chauhan, Yogesh Gopinath Chavan, Adelaide Claeysens, Michele Bertoldo Coelho, Nicolas Cristi, Phanindra D.V.S., Pratik Dabhade, Darius F. Dalal, C. Annal Deva Priya Darshini, Joydeep Das, Kaustav Das, Pritam Das, Shyam Das, Upasana Das, Subharthi Dasgupta, Tanuj Datta, Prakhar Dave, Mami Deka, Partha Pratim Deka, Avinash Deshpande, Laishram Saroda Devi, Ruchika Dhaka, Harleen Dhingra, Suraj Dhiwar, Payaswinee Dhoke, Samir Dhone, Gaurav Dhumatker, Harkeerat Dhunda, Athul Dileep, Anaya Atul Dixit, Dhatri M. Dongre, Vasudev Dubey, Sukanya Dutta, Eslam Elhosseiny, Johann Fernandes, Abata Ferreira, Piyali Ganguly, Samit Ganguly, Kanishka Gautam, Nipun Ghanghas, Prabir Gharami, Manoj Ghising, Tuhina Ghorui, Koushik Ghosh, Samrat Ghosh, Sushant G. Ghosh, Tathagata Ghosh, Evan Goetz, Ankur Gogoi, Abhinav Goyal, Prabir Kumar Halder, Purbasha Halder, Sandip Halder, Priya Hasan, Debasish Hazarika, Caroline Huang, Muhammed Irshad, Drishti Bharat Jadia, Sitha K. Jagan, Rohit Vikas Jain, Akhil Jaini, Ranjana Jaiswal, Nur Jaman, Jifar Raya Jemal, Aman Jha, Ketki Ashok Jogde, Jessy Jose, Jincen Jose, Madona Elizabeth Joseph, Prajwel Joseph, Minu Joy, Akhila K., Keerthi K., Sonali Kadam, Amoli Kakkar, Md. Mehedi Kalam, Pranav Kalsi, Csilla Kalup, Sammi Kamal, Sumukh Kamat, Kartik Kambhampati, Shashi Kanbur, Dhruv Kapoor, Rahul Kashyap, Vipin Kaushal, Devender Kawday, Vikram Kisan Khaire, Muskan Khan, Shourya Khanna, Ninad Khobrekar, Ankit Khunt, Ameya Kolhatkar, Dhairya Kotecha, Harshit Krishna, Vigneshwaran Krishnamurthy, Jens-Kristian Krogager, Gaurav Kumar, Himanshu Kumar, Nitesh Kumar, Pankaj Kumar, Saurabh Kumar, Krishna Aasrith Kuncham,

Andrea Kunder, Pankaj Kushwaha, Ioannis Kyriotakis, H. Lalthantluanga, Emanuela Luongo, Sakshi Satish Madekar, Ashish Mahabal, Sukanya Mallik, Soma Mandal, Goutam Manna, Sujay Vivek Mate, Harika Mohan Mavuru, Gustavo Medina Toledo, Rashmi Meena, Thokchom Yaiphaba Meitei, Stanimir Metchev, Anuj Mishra, Anwesh Kumar Mishra, Sai Swagat Mishra, Shikha Mishra, Swagat Mishra, Abhisek Mohapatra, Monmoy Molla, Sajahan Molla, Soumen Mondal, Sneha Prakash Mudambi, Atanu Mukherjee, Bhawna Mukhika, Nikhil Mukund, Riya Mullick, Masum Murshid, Rahul Musale, Niranjan Myneni, Kavya N.S., Rajesh Nayak, Sneha Nedhath Divakaran, Joe Philip Ninan, Delphine Nishimwe, Devendra Ojha, Akash P., Sreebala P.S., Archana Pai, Subramanya Pailoor, Satyajit Pal, Subhajit Pal, Dimple Panchal, Bibhudatta Panda, Saanvi Pande, Avinash Chandra Pandey, Jeevan Pandey, Sanjay Pandey, Ashish Pandita, Ketan Chandrakant Parab, Parth Pariwandh, S. Partheeban, Ankit Patel, Sarika Patil, B.C. Paul, Devraj Pawar, Bikram Phookun, Abhishek Sharad Potdar, Anirudh Pradhan, Kumar Pranshu, Sahil Purabiya, Lakshmiopathy R., Farook Rahaman, Divya Rana, Mahesh Rangarajan, Nikita Rawat, Mohd. Rehan, Marina Rejkuba, Francesco Di Renzo, Johan Richard, Ashmita Roy, Sayani Maity Roy, Prabir Rudra, Ambika S., Nagabhushana S., Sreedevi Mohan S., Mohamed Sabour, Sonali Sachdeva, Pamelia Saha, Subhajit Saha, Sanjay Kumar Sahay, Sunder B. Sahayanathan, Pradyumn Kumar Sahoo, Kailash Sahu, Sahil Saini, Aritra Sanyal, Subrata Sarangi, Biplob Sarkar, Janmejy Sarkar, Rajdeep Sarkar, Snigdha Sarmah, Subhadip Sau, Kumar Saurabh, Bonanza Sebastian, Pranjal Sengupta, Rikpratik Sengupta, Mohd Shahalam, Abhishek Sharma, Anamika Sharma, Isha Sharma, Karan Sharma, Priya Sharma, Saurabh Sharma, Shubham Sharma, Subah Sharma, Vaibhav Sharma, Md. Salim Shekh, Mayur Shende, Parisee Sunil Shirke, Ashish Shoukrin, Sumit Kumar Shrivastava, B.S. Shylaja, Amar Pal Singh, Deobrat Singh, H.P. Singh, Namrata Singh, Prasoon Ashok Singh, Ramanshu P. Singh, T.P. Singh, Shrikant Avdhutrao Solanke, Siddharth Soni, S. Sridhar, Holly Stokes-Geddes, Nirpat Subba, Annapurni Subramaniam, S. Sunil, Bhavesh Suthar, Teruaki Suyama, Bishnu Teli, Niranjan Thatte, Gujjeti Thirupathi, Aparajit Tripathi, Shafiqat Ul-Islam, Sanil Unnikrishnan, Lohit Chandra Upadhyaya, Namita Uppal, Amnish Vachher, Esther Vanlalramchani, Anne Verhamme, Nagaraj Vernekar, Monika Vij, R. Vijayaraghavan, G. Vinay Kumar, Yogesh Prabhakar Wagh, Faheem Aalijah Wani, Abhay Pratap Yadav, Nelakanti Mallikarjun Yadav, Shubham Yadav.

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We welcome your feedback at the following address:

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