Aryabhatta Research Institute of Observational Sciences

(An Autonomous Institute under DST, Ministry of Science & Technology, Govt. of India)

ANNUAL REPORT 2023-24

20 years

आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
Aryabhatta Research Institute of Observational Sciences
(An Autonomous Institute under DST, Govt. of India)
Manora Peak, Nainital

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Front Cover: A nightscape of 4m ILMT with the Milky Way at the Devasthal Observatory, ARIES, Nainital.
(designed by: Krati Soni, image courtesy: Sarath Prabhav)

Back Cover: A beautiful view of star trails from the 3.6m DOT at the Devasthal Observatory, ARIES, Nainital.
(image courtesy: Sarath Prabhav)

September, 2024

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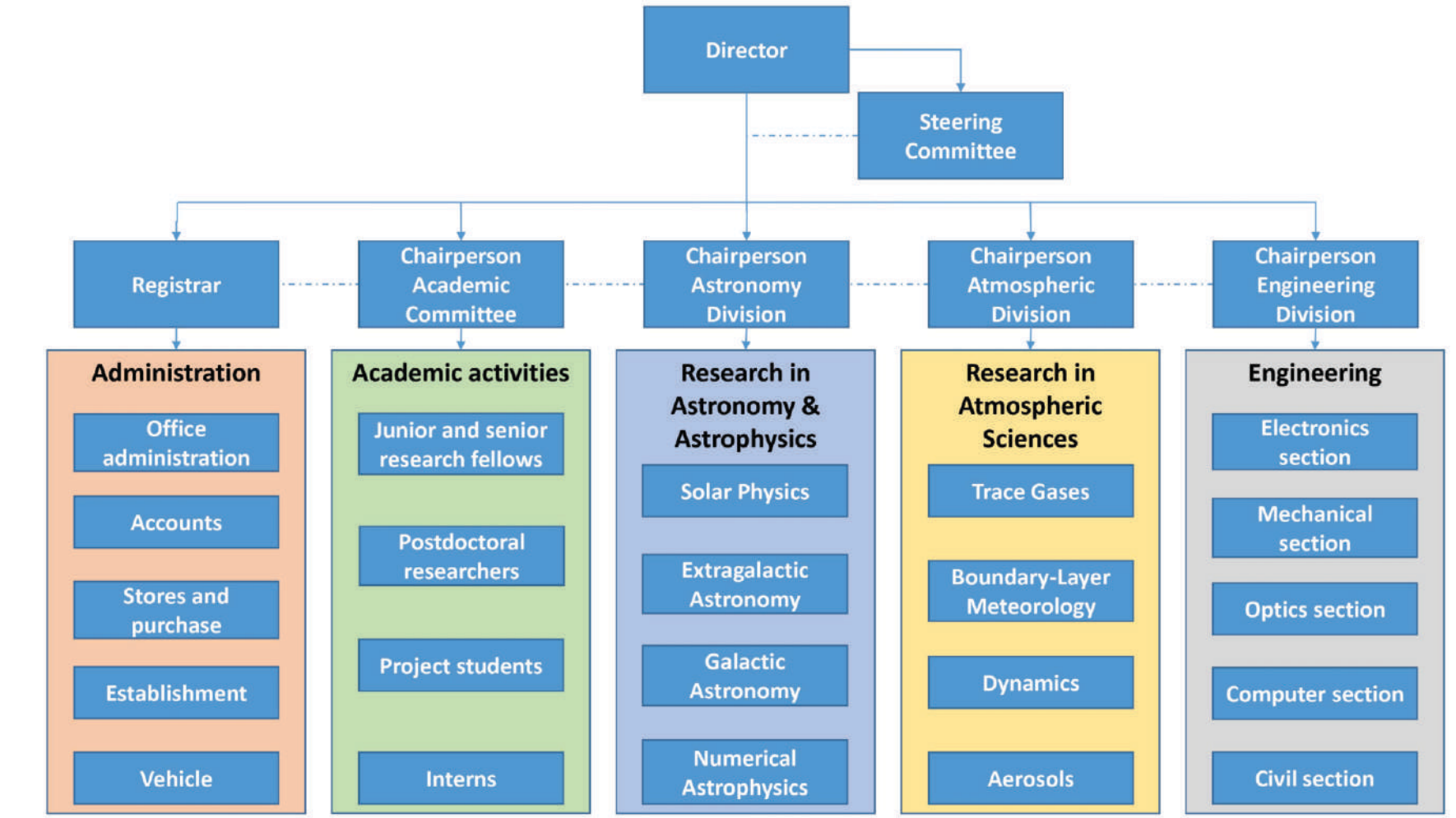

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The Year in Review

It is always a great pleasure to look back and present the highlights of our accomplishments over the last year, even more so due to ARIES completing 20 years since its foundation in March 2024. However, this journey would not have been possible without the unwavering support of my colleagues at ARIES, DST and other collaborating institutes. I am deeply indebted for their generous contribution and commitment in this endeavour. This report gives an overview of what ARIES achieved in 2023-24.

ARIES has three primary divisions – Astronomy & Astrophysics (specialising in observational and theoretical studies of various celestial objects); Atmospheric Sciences (specialising in the physical, chemical and dynamical processes governing the Earth's lower atmosphere); and Engineering (specialising in the design, development, maintenance and upgradation of the observational facilities and other infrastructure).

The pristine dark skies of *Devbhoomi* Uttarakhand provide an ideal location for observing the Universe. ARIES is fortunate to have access to two such locations in Nainital – Manora Peak and Devasthal. Being a world class site for optical astronomy, Devasthal Observatory hosts many state-of-the-art observational facilities established by ARIES, namely 4m International Liquid Mirror Telescope (ILMT), 3.6m Devasthal Optical Telescope (DOT) and 1.3m Devasthal Fast Optical Telescope (DFOT). The Manora Peak campus hosts 1.04m Sampurnanand Telescope (ST), which is one of the oldest operational telescopes, and atmospheric science facilities such as the ARIES Stratosphere Troposphere Radar (ASTRAD).

Being the largest all-sky optical telescope in Asia and a national facility, the DOT is open for astronomers across India and Belgium. Proposals were solicited in two four-month long observing cycles. These proposals were evaluated on their scientific merit, and were accordingly allocated observing time. Observations from the DOT provide good quality data resulting in important findings and publications in high impact peer reviewed journals. Significant progress has been made on two second generation instruments for the DOT - Side Port IMager (SPIM) and High Resolution Spectrograph (HRS). The recently inaugurated ILMT, a shining example of our international collaborative efforts, commenced science observations and the data produced was made available to the scientific community in two separate releases. I am proud to inform the readers that a fully automated data pipeline for calibration of ILMT data has been developed entirely within ARIES. The beta version of the data archive containing data from our 1m class telescopes is undergoing testing within the institute. Following the testing phase, this archive will be released publically for the global scientific community.

The Aditya-L1 Support Cell (AL1SC), a joint effort of ARIES with ISRO, conducted 3 workshops in different parts of the country and trained over 130 MSc/ Int. MSc/ Int. PhD/ BTech/ MTech students in solar physics, space weather, current open problems, the Aditya-L1 mission, and observational data analysis. With Aditya-L1 already in space, AL1SC will be conducting more such workshops with real data from the mission to help create a larger user pool and further develop the solar physics community in the country. With more and more avenues opening up in the space sector and its strategic importance, sun and space weather research will have direct implications in the coming days.

Astronomers at ARIES are involved in research on a wide spectrum of topics in Astronomy covering solar physics, galactic and extragalactic astronomy, theoretical studies and numerical simulations of astrophysical jets, compact objects etc. These studies include not only telescopes within ARIES, but many other national and international facilities as well. This also develops strong collaborations nationally and internationally.

There were many important findings from ARIES during the past year, some of which I am briefly mentioning. The theoretical and numerical studies group developed a novel

methodology to compute emission from accreting neutron stars. They also found that a change in the plasma composition leads to difference in the propagation velocities of astrophysical jets even if the initial parameters for the jets remain the same. The stellar group discovered systems of two blue straggler stars orbiting around each other in an open cluster in our galaxy using the Ultra-Violet Imaging Telescope (UVIT) onboard AstroSat, India's first dedicated space observatory. The extra-galactic astronomy group studies some of the most exotic objects in the Universe. Modern tools such as machine learning techniques revealed two distinct progenitor populations of kilonova-associated gamma-ray bursts (GRBs). By measuring a property called 'polarisation' of light, the secondary black hole in a unique binary blazar system 5.2 billion light years away was detected for the first time. Another study successfully explained persistent 'hiccups' from a black hole at the centre of a far-off galaxy being observed due to a tiny black hole repeatedly punching through the larger black hole's disk of gas. This ground-breaking discovery has shed light on previously unseen behaviour in black holes. The solar physics group developed an extensive database connecting giant solar eruptions to their birth places on the Sun. This led to many interesting results that show that giant solar eruptions bear the imprint of their origins. The study was published in the prestigious Astrophysical Journal Supplement Series and the source region catalogue is available online through the Aditya-L1 Support Cell (AL1SC) website.

Our Atmospheric Sciences group is involved in understanding the processes governing the Earth's atmosphere, air pollution and climate change. Observations from ASTRAD were used to study optical turbulence over the central Himalayan region and quantify the monthly variations in astronomical seeing conditions. The dynamics of hailstorms and deep convections during monsoon and pre-monsoon periods over this region were studied. A pioneering approach to continuously quantify CO contributions from fossil fuel combustion and biomass burning was developed, addressing a critical gap. The results of this study are of paramount importance for targeted air quality management strategies in this eco sensitive zone. The origins of carbonaceous aerosols in the Himalayas were unveiled by using extensive high-resolution ground-based observations and found that the influence of fossil fuel combustion extends throughout the year with a greater impact on warming than biomass burning. Another highlight was the installation of PANDORA instrument for observing different trace gases and smart sensors for observing PM2.5, CO and NO_2 in collaboration with Japan.

A reputed International Journal, Journal of Astronomical Instrumentation, published a special issue on ARIES, introducing the key observational facilities and recent scientific results from these facilities. The total number of publications from the institute in peer-reviewed journals and conference proceedings was 131.

Our state-of-the-art observational facilities remained operational thanks to the skillful technical human resource and full-fledged laboratories available in the engineering division. The division caters to design, development, maintenance and upgradation of the sophisticated back-end instruments and support facilities as well as the maintenance of the ARIES infrastructure. The core engineering sections - optics, mechanical, electronics and computer - have adopted an integrated and interdisciplinary approach to work in synergy and make optimum use of the resources. The development of additional laboratories and other supporting infrastructure at the Devasthal Observatory campus is progressing smoothly. Our administration very well supported the scientific and technical members.

An important factor in quality research in the modern world is scientific collaborations. ARIES has continued existing collaborations and established new ones on a plethora of projects. During the past year, we signed MoUs with National Institute of Technology (NIT) Delhi and Indian Institute of Technology (IIT-BHU) Varanasi to foster academic collaborations in the areas related to Physics, Astronomy & Astrophysics, Astronomical instrumentation and Atmospheric Sciences. We also entered an agreement with ISRO on the PATRIOT telescope project as part of the MoU on Space Situational Awareness (SSA). ARIES continued to play a significant role in upcoming major national and international megaprojects such as the Thirty Meter Telescope (TMT), National Large Solar Telescope (NLST), National Large Optical Telescope (NLOT) and INdian Spectroscopic Imaging Space Telescope (INSIST).

Conferences/workshops/schools are an integral part of science research where the community discusses their ideas, results and explores future possibilities. Such events are particularly beneficial for the young and early career researchers. ARIES organised eight such meetings during the previous year, namely "ARIES Training School in Observational Astronomy (ATSOA-2023)" during 17-28 April, 2023; ii) "ARIES In-house meeting - 2023" during 23-24 May 2023; iii) "4th AL1SC workshop" during 28 June

- 7 July, 2023; iv) "5th AL1SC workshop" during 29 September - 1 October, 2023; v) "Advances in Relativistic Astrophysics (AReA)" during 2-4 November, 2023; vi) "Beyond Aditya-L1: Exploring the future of Indian solar physics from space" during 7-9 November, 2023; vii) "Winter School on Concepts in Solar Physics-2023" during 19-23 December, 2023; viii) "6th AL1SC workshop" during 6-8 February, 2024. The first three of these were a part of the Azadi Ka Amrit Mahotsav commemoration activities at ARIES.

In addition to being a knowledge creator, a scientist has a moral obligation to spread that knowledge among the young students and society-at-large in such a manner that a non-expert audience can also grasp it. ARIES is deeply committed to this principle, and runs a vibrant science communication and public outreach programme. We opened a new science centre for visitors at the Devasthal Observatory campus on 9 October, 2023 in the memory of Padma Bhushan Prof. Shri Krishna Joshi to further enhance our outreach efforts. We celebrated the National Science Day during 16-28 February, 2024 and students from schools, colleges and universities from nearby places visited ARIES for lectures, tours of observational facilities and stargazing. Before and after the launch of the Aditya-L1, ARIES members participated in many public outreach and media engagement events in multiple cities across India in association with other science popularisation bodies. The outreach team participated in a nationwide study by conducting a survey on Astronomy education in nearby schools representing Uttarakhand. Thematic outreach programmes were also conducted on World Space Week, Geminid Meteor Shower etc. ARIES also participated in many exhibitions and events such as Government Achievements & Schemes Expo-2023, New Delhi; Vibrant Uttarakhand 2023, Haridwar; International Science Festival (IISF) 2024, Faridabad; Gatisheel Jammu Aur Kashmir… Atmanirbhar Bharat Ki Or, Jammu; Pratham Akhil Bhartiya Vaigyanik aur Takniki Rajbhasha Sangoshthi – 2024, Hyderabad etc.

We have been among the leading institutes in the country in developing skilled human resources in Astronomy, Atmospheric Sciences and Instrumentation through our academic programme. 13 Junior Research Fellows (JRFs) joined ARIES to pursue Ph. D. and 10 Post Doctoral Fellows (PDFs) were appointed during 2023-24. 16 students were awarded Ph. D. degree, while 1 submitted their thesis. 52 undergraduate and postgraduate students from science and engineering disciplines were trained by ARIES members through short-term internships. A new hostel block is under construction at our Manora Peak campus to accommodate the increasing numbers of students.

To spread and encourage usage of Hindi, ARIES participated in many activities and undertook new initiatives. ARIES members also participated in activities organised by the Town Official Implementation Committee of the Nagar Rajbhasha Karyanvayan Samiti (TOLIC/ NaRaKaS). These efforts led to ARIES being awarded the TOLIC shield and the 1st prize of NaRaKaS, Haldwani. Several awareness programmes were conducted on other important occasions such as International Day of Yoga on 21 June, 2023; Hindi Maah during September, 2023; Swachhta Pakhwada during 15-30 September, 2023; Special Campaign 3.0 during 15-30 September and 2-31 October, 2023; Vigilance Awareness Week during 30 October-5 November, 2023 with the theme "Say no to corruption; commit to the Nation"; Ayurveda day on 10 November, 2023; Sexual Harassment at Workplace Prevention Week during 4-9 December, 2023; Vishwa Hindi Diwas on 10 January, 2024 etc.

Our scientific and engineering strength was 23 (including an INSPIRE faculty and a project scientist) and 12 respectively. The other staff consisted of 14 members in administration, 28 scientific and technical staff, and 6 laboratory assistants and support staff. The number of PDFs and research scholars was 26 and 69 respectively. ARIES is deeply committed to provide a safe and equitable environment at work for its members, especially for *Nari Shakti*, scheduled caste and tribes and *Divyangs*. The grievances of the staff members are promptly addressed. Various essential schemes following the Government of India directives are strictly adhered to and implemented.

I have no doubt that we will continuously enhance the research and development activities with our world class observational facilities and contribute further in key national and international projects. We will continue to strive for making important contributions in fundamental science research for realising the goal of a Viksit Bharat in the near future.

Dipankar Banerjee
Director

Research Highlights

The scientists, research scholars and post doctoral fellows at ARIES are involved in core research in Astronomy & Astrophysics (A&A), Atmospheric Sciences and Instrumentation. These are performed under the three primary divisions at ARIES utilising their resources and expertise. The brief research highlights of the institute, during the period 2023-24, are given below.

Astronomy & Astrophysics (A&A) Division

The A&A division conducts research centered around the Sun and the Solar System, Galactic sources (near earth objects, individual stars, star clusters and star forming regions), Extragalactic sources (external galaxies, active galactic nuclei, time domain studies of transients) and Theoretical and numerical simulations of compact objects.

Galactic Astronomy

In the galactic domain, major research topics at ARIES include the study of stellar populations, star formation, their evolution, variable stars, extrasolar planets, open clusters and globular clusters within the galaxy, the interstellar medium, synthesis of heavy elements, eclipsing and compact binaries to determine precise stellar parameters, investigating the role of rotation and magnetic fields in various physical processes occurring inside stars. Research on accretion flows in cataclysmic variables helps to reveal the flow of matter during binary interactions and in the vicinity of compact objects. Additionally, the study of pulsars and neutron stars is actively pursued, contributing to a deeper understanding of high-energy astrophysical processes.

Exploring the Galactic Structure using Open Star Clusters

An exhaustive study of about 2000 open star clusters revealed a stark revelation regarding disparate chemical evolution within the inner and outer boundaries of the Milky Way Galaxy. These clusters, spanning a broad age spectrum ranging from few millions years to several billions of years, offer a unique window into the gradual chemical evolution of our galaxy over the past ten billion years. Two distinct components were identified along the vertical axis of the galactic midplane which clearly reveals two components of the galactic structure known as the thin and thick galactic disks. Moreover, along the galactic plane, a pronounced decline in metallicity was observed, followed by a gradual tapering after approximately 13 kiloparsecs from the galactic centre. The open clusters formed within the past 240 million years exhibited higher metallicity compared to their older counterparts **[Joshi, Y. C., Deepak** & Malhotra, S. (2024). *Front. Astron. Space Sci., 11*: 1348321 (15pp)**]**.

The understanding of the Milky Way has progressed immensely due to the Gaia survey data as thousands of new open star clusters are detected and precise physical parameters are derived. Open clusters serve as excellent tracers for probing the structural details of the galactic disk. The largest open cluster catalogue of more than 6000 clusters compiled in the post-Gaia era was utilised to provide an observational view of the galactic disk. Using the physical parameters like age, distance, reddening, and kinematic information of the clusters, the spiral structure of the galaxy was mapped. It was found that most of the clusters start migrating away from the spiral arms in about 10-20 Myr and fill the inter-arm regions with progressing age. Using the 3D kinematic information of 371 open star clusters, different individual pattern speeds for spiral arms were derived indicating the transient nature of the Milky Way's spiral arms. Based on the distribution of clusters younger than 700 Myr, a solar offset of $z_{\odot}$ = 17.0 ± 0.9 pc north of the galactic plane was found, and the scale height was estimated as zh = 91.7 ± 1.9 pc from the galactic plane **[Joshi, Y., C.** & Malhotra, S. (2023). *Astron. Jr., 166:* 170 (9pp)].

Accretion Flows in a Magnetic Cataclysmic Variable

Multi-wavelength observations were used to investigate multiple periodic variabilities in magnetic cataclysmic variables (MCVs), which helped unveil the nature of accretion flows and allows for their proper characterization. A comprehensive study of three MCVs, namely IGR J15094-6649, 1RXS J174320.1−042953, and YY Sex were carried out using multi-wavelength observations. The extensive data taken from several ground- and space-based telescopes including the 1.3m DFOT refined the spin and/or orbital periods and detected other significant periodicities. The source IGR J15094-6649 is an intermediate polar (IP), whereas the sources 1RXS J174320.1−042953 and YY Sex were characterised as polars. The first clear evidence of a beat period of 14.028 minute was found in IP IGR J15094-6649. The prevalence of X-ray and optical spin pulses in

IGR J15094-6649 revealed the dominance of disc-fed accretion. Yet, the detection of an additional beat frequency suggested that a portion of the accreting material follows the magnetic field lines as well. Photoelectric absorption appeared responsible for the soft X-ray (<10 keV) modulation. However, complex absorbers may be responsible to produce low amplitude spin modulations via Compton scattering in the hard (>10 keV) energy band and indicate that the height of the X-ray emitting region may be negligible or close to the white dwarf (WD) surface. The presence of double-humped X-ray profiles with a pronounced dip was indicative of photoelectric absorption in the intervening accretion stream.

In the sources 1RXS J174320.1−042953 and YY Sex, the optical spectra showed several emission lines, including strong hydrogen Balmer lines with strong He II 4686 A and Hβ. The polar 1RXS J174320.1−042953, exhibited two distinctive high and low states, accompanied by a noticeable phase shift as shown in **Figure 1**. This phenomenon could be due to changes in the configuration, dimensions, and/or positioning of the accretion region. Its orbital X-ray modulations persisted in the soft (0.3–2.0 keV) energy band, likely due to photoelectric absorption within the accretion flow. A fraction of hard X-rays is reprocessed and reradiated in soft X-rays; however, no evidence of soft X-ray excess in this source was found. It was found that the WD is accreting mass from the secondary with a rate of ~5 × 10-12 M/yr. The low and high states in the long-term light curve, the presence of only one period and its harmonics, detection of orbitally modulated circular polarisation, and emission-line features in the optical spectrum confirmed that YY Sex belongs to the category of polars. [Joshi, Arti et al. (including **Rawat, Nikita, Pandey, J. C.** & **Rao, Srinivas M.**). (2023). *Mon. Not. Roy. Astron. Sco., 521*, 6156-6169; **Rawat, Nikita** & **Pandey, J. C.** et al. (including **Rao, Srinivas M.**). (2023). *Mon. Not. Roy. Astron. Sco., 521*, 2729-2744].

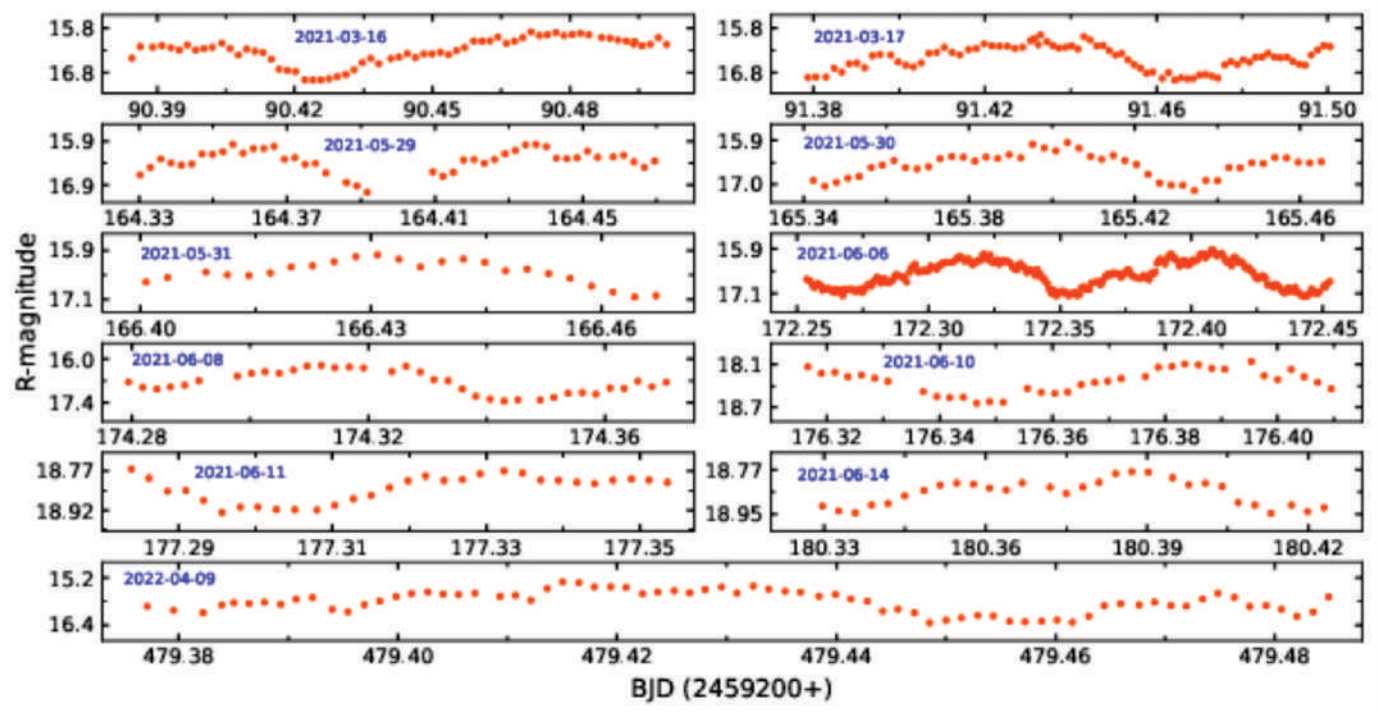


Figure 1. Orbital phase folded R-band light curves of 1RXS J174320.1−042953 taken from different telescopes of ARIES and Uzbekistan. The low and high states are clearly noticeable among different epochs of observations.

Energetic X-ray super-flares

AB Dor A (=AB Dor) is a young, active, and a member of a pre-main-sequence quintuplet stellar system AB Doradus at a distance of 15.0 ± 0.1 pc. Its youth and fast rotation make it a very active star among the solar-type stars. The quiescent and flaring states of AB Dor were analysed and studied in detail using the observations from XMM-Newton satellite. The quiescent state of AB Dor consists of three temperature plasma with an average value of the temperature, emission measure, and abundances of 0.94 keV, 4.6×10^{52} cm^{-3}, and 0.2 $Z_{\odot}$, respectively. Total 21 flares were detected from six observations of AB Dor with a flare-to-quiescent state count rate ratio of 2-4 for the majority of the flares, whereas the duration of these flaring events was found to be 0.7-5.8 h. The most powerful flare occurred in 2016 with flare-to-

quiescent state flux of 34, emerging as the third most powerful flare following the two stronger ones documented during the BeppoSAX observations in 1997. In most flares, an increase in abundance and density was observed, suggesting chromospheric evaporation. The elemental abundances exhibit an inverse FIP bias in both quiescent and flaring conditions. The height of the loops in these flares doesn't exceed 50 % of the stellar radius. Additionally, the erupted mass of the CMEs appears to be 10 to 100 times higher than the most massive solar CME. A rotational modulation appears in most X-ray light curves of AB Dor, possibly due to the stellar surface eclipsing of the coronal active regions. Temporal evolution of the spectral parameters of AB Dor during flares and quiescent states during 2001 epoch of observations is shown in **Figure 2** [Didel, Shweta, **Pandey, Jeewan C.**, Srivastava, A. K. & **Singh, Gurpreet**. (2024). *Mon. Not. Roy. Astron. Soc., 527*, 1705-1721].

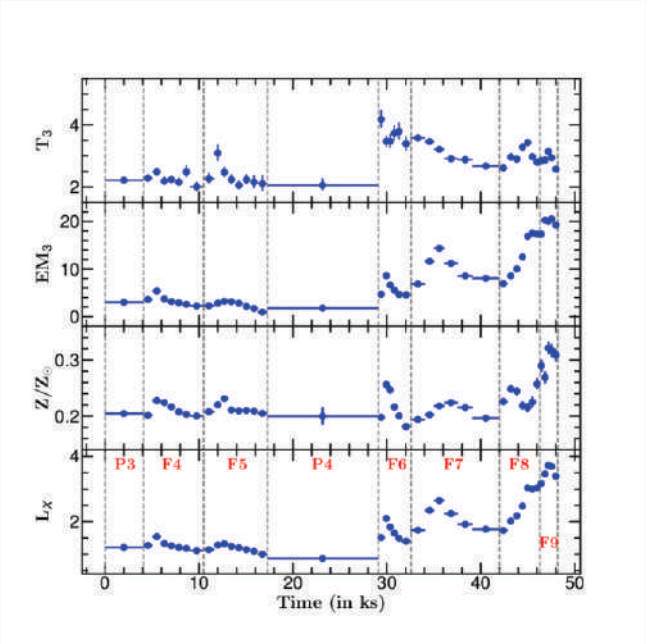


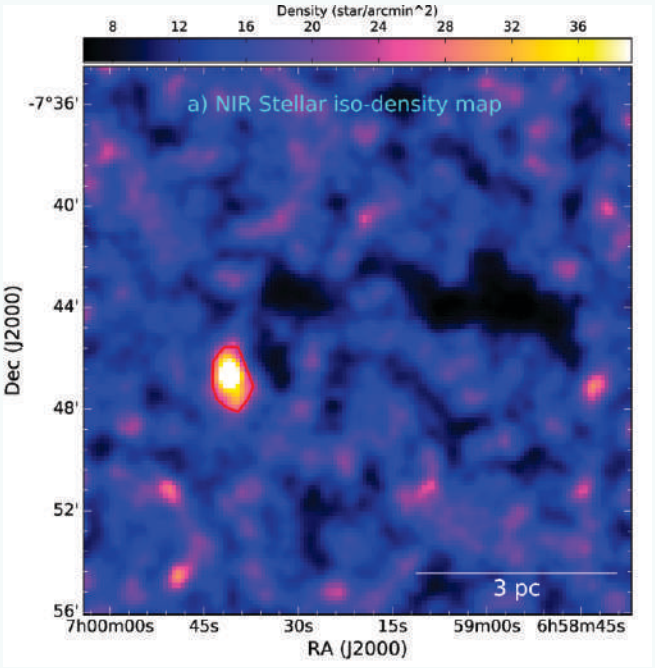
Figure 2. Temporal evolution of the spectral parameters of AB Dor during flares and quiescent states during 2001 epoch of observations, where top to bottom plots show the variation of temperature (T_3) in units of 10^7 K, emission measure (EM_3) in units of 10^{52} cm^{-3}, relative abundance ($Z/Z_\odot$), and X-ray luminosity in units of 10^{30} erg s^{-1}.

Star Formation and Young Stellar Objects

The stellar cluster NGC 2316, was found to be associated with a filamentary cloud. The study of NGC 2316 revealed the existence of a dark lane (absence of stars; left panel of **Figure 3**) starting near the cluster region and extending towards the other direction as a filamentary structure due to the high extinction of the material there. On studying a larger region, the dark lane was found to be part of a larger molecular filamentary structure (right panel of **Figure 3**). Investigation of star-forming complex S193 was also performed using near-infrared (NIR) observations and archival data covering optical to radio wavelengths. Using the mid-infrared (MIR) and far-infrared (FIR) images, the distribution of the dust emission around HII regions is traced in the complex. Colour composite image of the S193 complex is shown in **Figure 4**.

To understand the star formation scenario in the galactic MIR Bubble [HKS2019] E70, multiwavelength observations were used. A small (radius ~ 1.7 pc) stellar cluster inside the E70 bubble was found at a distance of 3.26 ± 0.45 kpc. This cluster is embedded in the molecular cloud and hosts massive stars, as well as young stellar objects (YSOs), suggesting active star formation in the region. The spectral type of the brightest star (M1) of the E70 cluster is estimated as O9V, and a circular ring/shell of gas and dust is found around it. The diffuse radio emission inside this ring/shell, the excess pressure exerted by the massive star M1 at the YSO's core, the distribution of photodissociation regions, a class I YSO, and two ultra-compact HII regions on the rim of this ring/shell clearly suggest a positive feedback of the star M1 in the region. Two-colour diagram for the sources in the E70 region is shown in **Figure 5**. In summary, evidence was found for the formation of massive stars in the hub of a hub- filamentary system. Star formation does not cease after the formation of a massive star, in-fact it further triggers the next generation of stars in its periphery. Evidence of formation of young stars even in older clusters through accretion of gas was found when the clusters pass through the molecular cloud. IMF of young clusters in the mass range about ~30 - 0.6 $M_\odot$ can be represented by a power law with a break around 1-2 $M_\odot$. It was found that the IMF varies from one cluster region to another. Mass segregation was observed in many young star clusters and concluded that the massive stars tend to form in the inner core region of the star cluster **[Sharma, Saurabh, Verma, Aayushi, Mallick, Kshitiz** et al. (including **Panwar, Neelam, Chand, Tarak** & **Agarwal, Mamta**). (2024). *Astron. Jr., 167*: 106, Dewangan, L. K. et al. (including **Sharma, Saurabh**). (2024). *Mon. Not. Roy. Astron. Soc., 528*, 3909-3926; Dewangan, L. K. et al. (including **Sharma, Saurabh**). (2023). *Jr. Astrophys. Astr., 44*: 23(12pp); **Pandey, Rakesh** & **Sharma, Saurabh** et al. (including **Panwar, Neelam, Ghosh, Arpan** & **Verma, Aayushi**). (2024). *Mon. Not. Roy. Astron. Soc., 527*, 9626–9642; Bhadari, N. K. et al. (including **Sharma, Saurabh**). (2023). *Mon. Not. Roy. Astron. Soc., 526*, 4402-4417; Kaur,

Harmeen & **Sharma, Saurabh** et al. (including **Verma, Aayushi, Panwar, Neelam** & **Ghosh, Arpan**). (2023). *Jr. Astrophys. Astron., 44*: 66 (11pp);**Verma, Aayushi, Sharma, Saurabh** & **Mallick, Kshitiz K.** et al. (including **Ghosh, Arpan, Panwar, Neelam** & **Chand, Tarak**). (2023). *Astrophy. Jr., 953*: 145 (18pp)**]**.



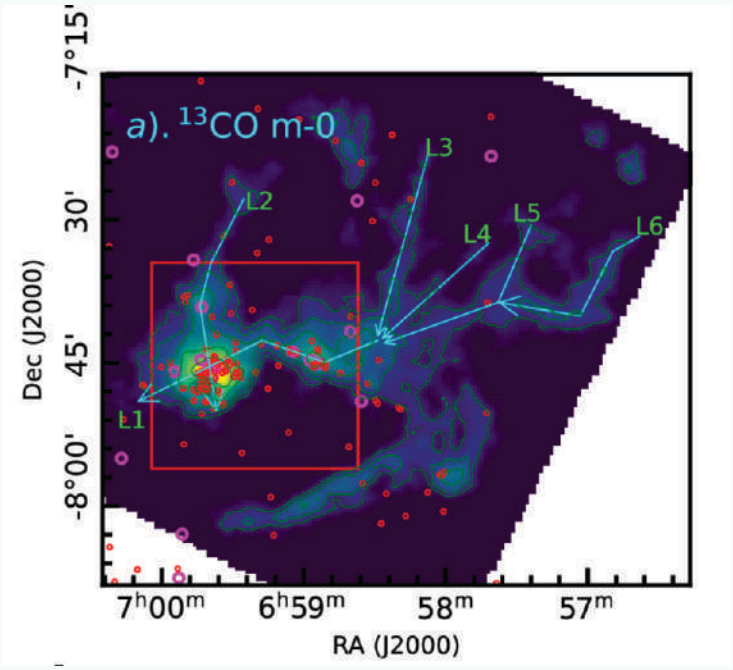
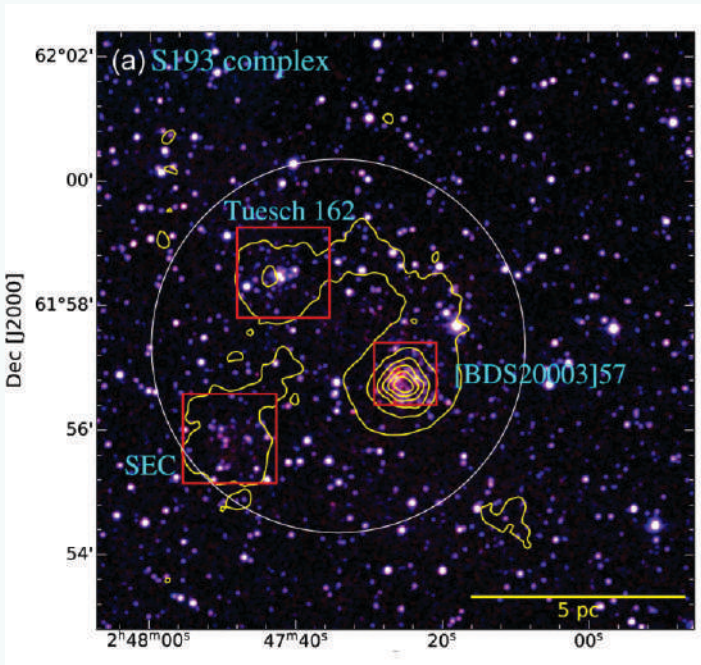


Figure 3. Left: Stellar density map derived from the near-infrared (NIR) catalogue. **Right:** The 13CO(1–0) integrated intensity (moment-0) map overlaid with the locations of young stellar objects (NGC 2316).



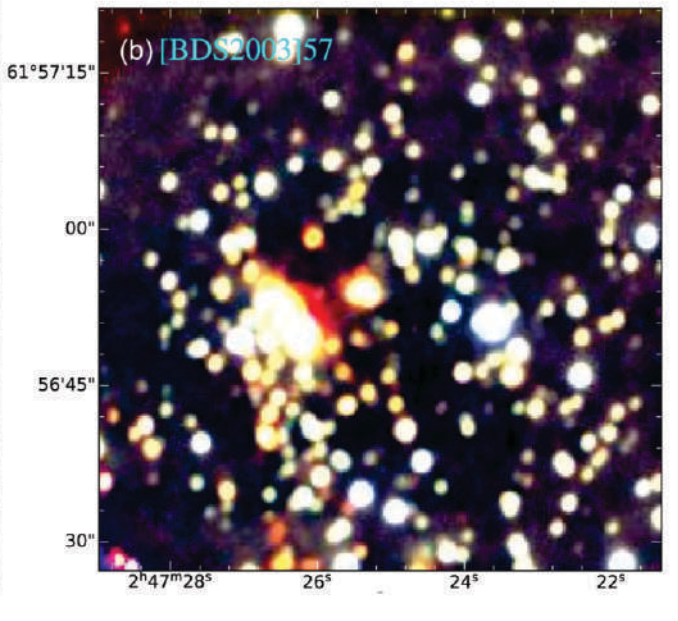


Figure 4. Star forming complex region S193. **Left:** Colour composite image of the S193 complex made using 2MASS K (red), H (green), J (blue) band images. The surface density contours are shown in yellow colour, while the core region of the three clusterings ([BDS2003]57, T162, and SEC) is marked with red squares. **Right:** TANSPEC K (red), H (green), and J (blue) band colour composite image of the core region of the [BDS2003]57 clustering [FOV ~ 56 arcsec × 56 arcsec].

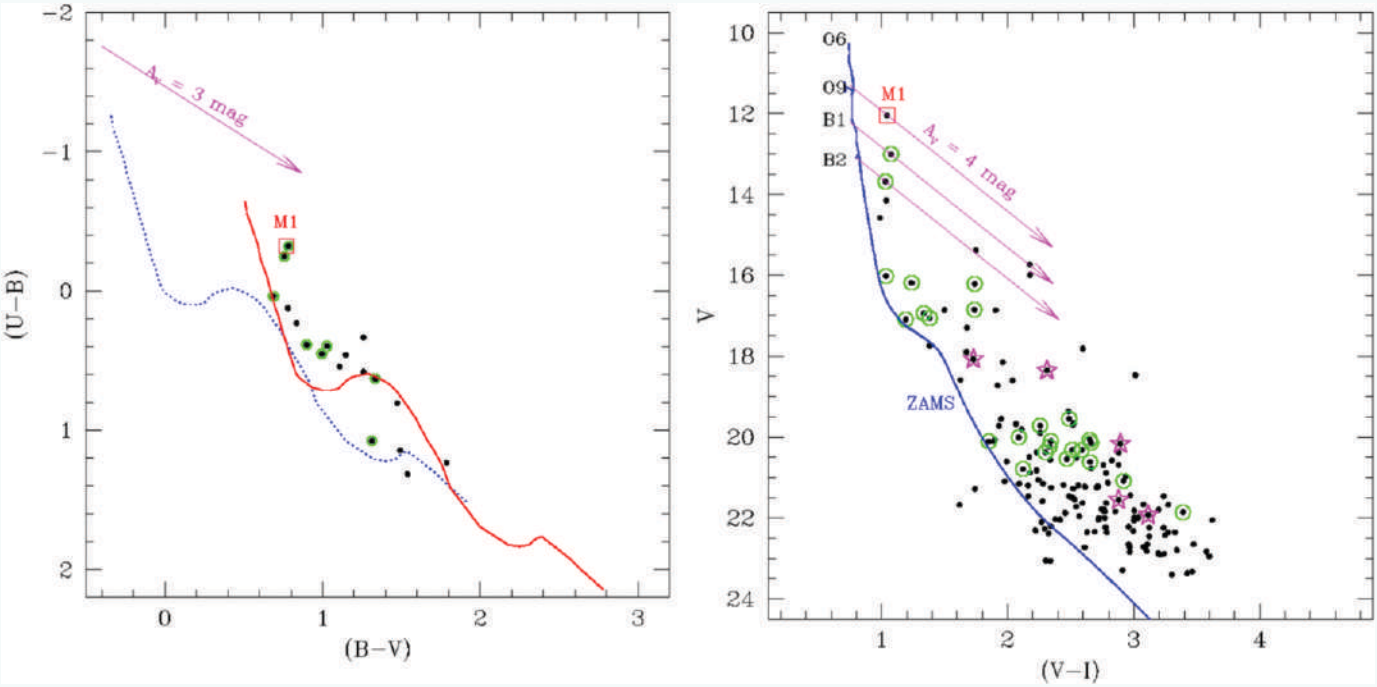


Figure 5. (Deep optical data from 3.6m DOT): ***Left:*** (U − B) vs. (B − V) TCD for the sources in the E70 region. The Gaia DR3 members are also plotted with green circles. The dotted blue curve indicates the intrinsic ZAMS for Z = 0.02 given by Pecaut & Mamajek (2013). The solid red curve indicates the ZAMS that is shifted along the reddening vector. ***Right:*** V vs. (V − Ic) CMD. The blue solid curve indicates the ZAMS isochrone by Pecaut & Mamajek (2013), corrected for a distance of 3.26 kpc and reddening E(B − V) = 0.85 mag. The PMS stars are shown by magenta stars. The massive star M1 is marked in both panels by a red square.

Young stellar objects (YSOs) that are actively accreting exhibit Hα emission lines in their spectra. A survey for Hα emission-line stars in the star-forming region IC 5070 was conducted using the 2-m Himalayan Chandra Telescope (HCT). Based on the Hα slitless spectroscopy data, 131 emission-line stars were identified within an area of approximately 0.29 square degrees in IC 5070. The mean proper motion and parallax of the emission-line stars were estimated using Gaia early data release 3. The mean distance and reddening toward the region were estimated using the emission-line stars, found to be approximately 833 pc and 2 mag, respectively. By examining the locations of these stars in the colour-magnitude diagrams constructed using Gaia and PanSTARRS1 data, it was found that the majority of the Hα emitters are young low-mass (<1.5 $M_{\odot}$) stars. This catalogue of emission-line stars were also compared with the available young stellar catalogues and found that most of them are class II/flat spectrum sources with the spectral type ranging from K to M. Based on the proper motion/parallax values and locations on the colour-magnitude diagrams, about 20 emission-line stars are flagged as non-members. The relative proper motion of the emission-line stars with respect to the ionising source **(Figure 6)** suggests the possibility of the 'rocket effect' scenario in the remnant cloud (BRC 31) **[Panwar N.**, Jessy Jose, **Rishi, C.** (2023). *Jr. Atrophy. Astron., 44 (2)*, 42**]**.

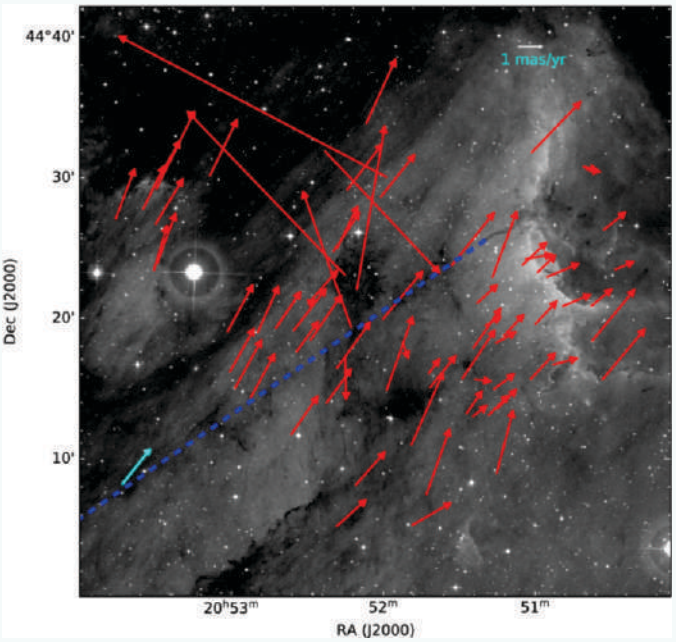


Figure 6. Proper motions of the emission line stars. The red arrows represent the relative proper motion vectors of the Hα stars with respect to the ionising star. Blue dashed line indicates the direction of the main ionising star.

Photometric and kinematic analyses of an intermediate-age open cluster NGC 1027 were performed using UBVRI data from the 1.04m Sampurnanand Telescope (ST) and Gaia Early Data Release 3 (EDR3). Structural and fundamental parameters, such as cluster centre, cluster extent, reddening, age and distance were estimated. Cluster centre was found about 4 arcmin away from the centre reported earlier. Using proper motion Gaia EDR3 data, membership probabilities have been derived for the stars in the region of cluster radius. The mean proper motion of the cluster was found to be approximately (−0.84, 2.04) mas yr-1 in (RA, Dec). A total of 217 most probable cluster members (Pμ > 70%) were identified, with a mean parallax of 0.892 ± 0.088 mas. Out of these, 160 members have counterparts in our optical observations. Few stars having Pμ>70 %, were found out of the cluster radius showing imprints of dynamical evolution. The colour-colour and colour-magnitude diagrams for the cluster members found within cluster radius have been constructed. This yields a reddening E (B -V) ~ 0.36 mag, age ~ 130 Myr and distance ~ 1.14 kpc. The mass function slope in the cluster region is Γ ~ -1.46 ± 0.15 , which is similar to other Galactic open clusters. A lack of faint stars in its inner region leading to mass segregation effect. A comparison of dynamical age with cluster age indicates that NGC 1027 is a dynamically relaxed cluster suggesting that mass segregation may be an imprint of its dynamical relaxation **[**Tripathi A., **Panwar, N., Sharma S., Kumar B.**, Rastogi S. (2023). *Jr. Atrophy. Astron., 44(2)*, 61 (11 pp)**]**.

Multi-wavelength spectro-photometric monitoring of episodically accreting young low-mass stars

Different photometric timescales (both rise/decay of flux) were observed in accreting young low mass stars, suggesting a complicated and non-unified model responsible for the outburst/accretion in them. The classical classification of episodically accreting YSOs into FUors and EXors needs revision as poorly investigated sample shows some of the intermediate properties. Samples of normalized optical-NIR medium resolution (0.4-2.4 μm) spectra of V2493 Cyg are shown in **Figure 7**. The outflow activities were confirmed during the periods of enhanced accretion, thereby lending further credence to the outflow driven accretion models. Evidence of variations in the wind acceleration emerging from the disc was identified. Also, the disc stability found to be linked to episodes of increased accretion. Evidence was found for the rebuilding of the inner disc following the outburst **[Ghosh, Arpan, Sharma, Saurabh** et al. (including **Panwar, Neelam, Pandey, Rakesh** & **Verma, Aayushi**). (2023). *Astrophy. Jr., 954*: 82 (19 pp); **Ghosh, Arpan, Sharma, Saurabh** et al. (including **Verma, Aayushi**). (2023). *Jr. Astrophys. Astr., 44*: 50(12pp); Singh, Koshvendra et al. (including **Ghosh, Arpan** & **Sharma, Saurabh**). (2024). *Astrophys. Jr., 968*: 88, (28pp); Singh, Koshvendra et al. (including **Sharma, Saurabh**). (2023). *Jr. Astrphy. Astron., 44*: 58 (8pp)**]**.

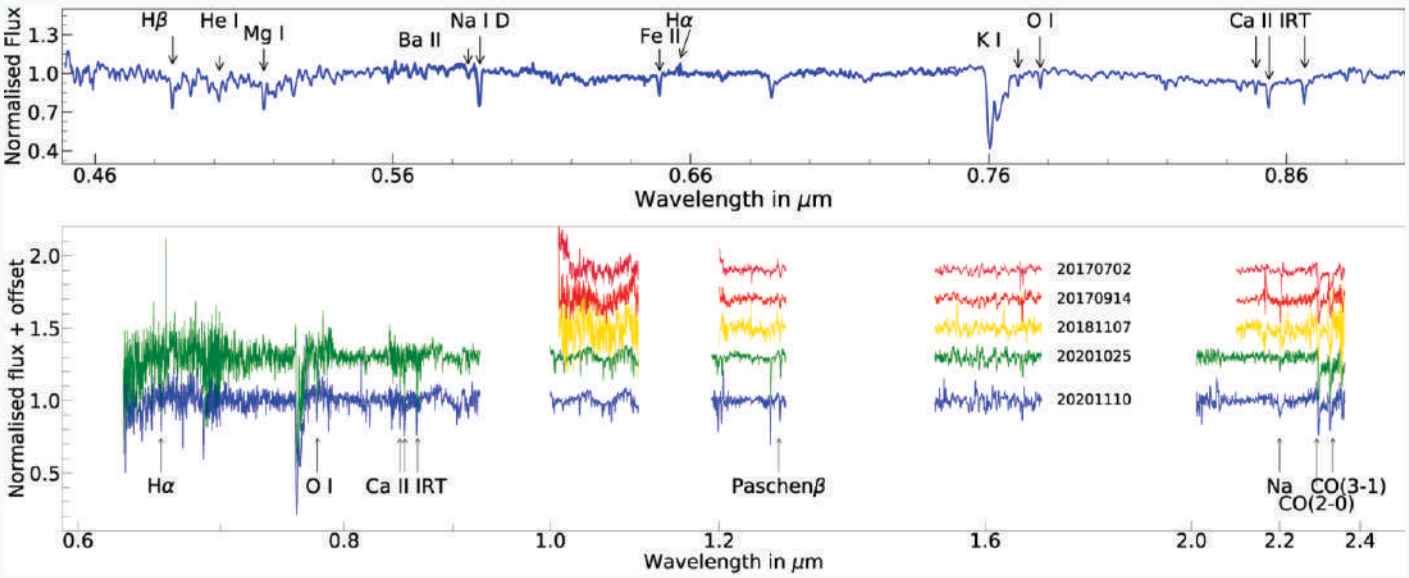


Figure 7. Sample of the normalised spectra of V2493 Cyg obtained using HFOSC on 2 m HCT (~ 0.4–0.9 μm; top panel), TIRSPEC (~ 1.0–2.4 μm; bottom panel) on 2 m HCT, and TANSPEC (~ 0.65–2.4 μm; bottom panel) on 3.6 m DOT.

Upgradation of ARIES Imaging polarimeter (AIMPOL) on 1.04-m ST telescope of ARIES

For the measurement of the stellar polarisation a polarimeter named AIMPOL was built in 2004. This instrument is being used to carry out a variety of science objectives that includes study of comets, interstellar polarisation, magnetic field structure of star-forming regions, molecular clouds, and cometary globule, active solar-type stars, GRBs and AGNs. These results showed the extensive usage and capability of AIMPOL for studying cosmic polarised sources, which encouraged us to upgrade the instrument by installing a new CCD due to the non-working conditions of the older CCD and replacing the sliding filter assembly with an automatic filter wheel assembly. CAD view and real picture of the upgraded AIMPOL with CCD detector is shown in **Figure 8**. The characterization of newly installed CCD, the Pylon 1300B CCD suggests that it can be operated for scientific observations between -70°C and -120°C due to the insignificant variation of dark current below -70°C . Dark counts were found to be ≈ 0.2 e-/pixel/h at -120°C. The bias offset was found to be ~600 ADU. No noticeable change variation is found in the mean bias and dark counts in different combinations of gain, readout speed, and binning. The CCD shows linearity up to the saturation limit of 216 . The nonlinearity of the CCD was found to be ≈2%, which is ideal for scientific observations. The degree of polarisation and position angle of polarised standard stars were found to be similar to those found in the earlier observations **[Pandey, Jeewan C., Singh, Sadhana, Yadav, R. K. S., Nanjappa, Nandish, Pant, Jayshreekar, Kumar, Mukesh & Sahu, Sanjit**. 2023. *Jr. Astron. Instru., 12*: 2240008 (11 pages)**]**.

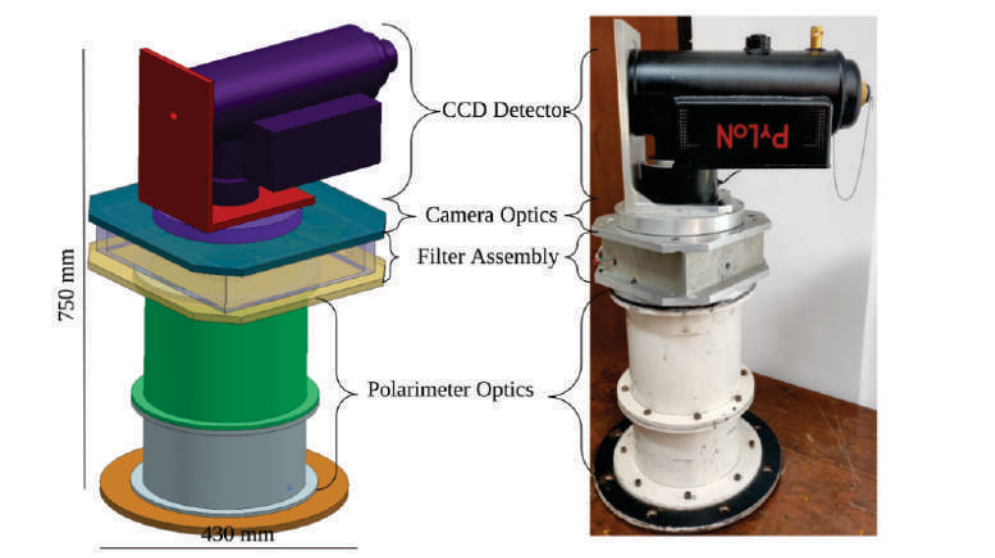


Figure 8. CAD view (left panel) and real picture (right panel) of the upgraded AIMPOL with CCD detector.

Extragalactic Astronomy

In this research area, multiwavelength observations are key to investigating the variability of Active Galactic Nuclei (AGN) across multiple wavelengths, including optical, X-ray, gamma-rays, and radio bands. This comprehensive approach provides insights into the complex emission mechanisms of AGN, helping to understand the nature of relativistic jets, accretion disks, and the environments around supermassive black holes. Multimessenger research on transients, such as Supernovae, Gamma-Ray Bursts (GRBs) and Tidal Disruption Events (TDEs) are also carried out to understand the energetic processes involved in these extreme phenomena.

Tidal Disruption Events

Tidal Disruption Event is a phenomenon when a star is disrupted by a black hole; a tremendous amount of energy is released. Pasham et al (Science Advances) discovered a new system that was quiet until December 2020, after which periodic bursts of gas emissions were observed every 8.5 days in X-rays, followed by a return to a dormant state. The galaxy hosts a central supermassive black hole (SMBH) with a mass of 50 million suns. Prior to the outburst, the black hole likely had a faint, diffuse accretion disk, with a second, smaller black hole (100 to 10,000 solar masses) orbiting it in obscurity. In December 2020, a

third object, likely a nearby star, ventured too close to the system and was shredded by the supermassive black hole's immense gravity. This sudden influx of stellar material brightened the black hole's accretion disk as the star's debris swirled into it. Over four months, the black hole consumed the stellar debris while the second black hole continued its orbit. As it passed through the disk, it ejected a significantly larger plume than usual, which was directed straight towards the NICER telescope. A pictorial presentation of the same is shown in **Figure 9**. **[**Pasham, D., R., Tombesi, F., Suková, P., Zajaček, M., **Rakshit, S.** et al. (2024), *Science Advances,* 10J8898P**]**.

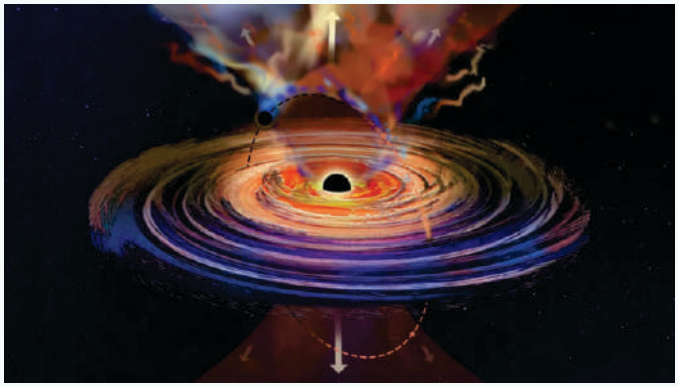


Figure 9. An intermediate-mass black hole orbiting a supermassive black hole, and driving periodic gas plumes that can explain the observations.

Active Galactic Nuclei

AGNs are extremely bright and energetic regions found at the centres of some galaxies, powered by supermassive black holes. 1ES1927+654, a nearby AGN, experienced an enigmatic optical/UV outburst followed by unusual X-ray variability from January 2022 to May 2023. During this period, its soft X-ray (0.3-2 keV) flux increased nearly fivefold, termed the "bright soft state," while the hard X-ray (2-10 keV) flux doubled and UV flux density remained stable (≤30% change). The energy emitted in soft and hard X-rays was ~3.57×10^{50} erg and 5.9×10^{49} erg, respectively, indicating that the soft excess (SE) region is emitting more energy than the UV or hard X-ray sources. The SE-emitting region, likely powered by accretion onto the supermassive black hole, is receiving most of the energy. This source deviates from the typical disk-corona relation found in AGNs, both during the initial flare (2017-2019) and the current bright soft state (2022-2023). **[Laha, S.**, et al. (including **Rakshit, S.**). (2023), *Astrophy. Jr., 955*, 3G].

Further, correlation of outflow kinematics with radio activity provides insights into the accretion rate of these objects. The outflow of the ionised gas in the AGNs can be explored using their radio emission activity. Radio emission and ionised gas measurements have been used for 6000 active galaxies and used to group these galaxies into strong/weak, AGN-dominated/star-formation contaminated, compact/extended, and loud/quiet types. Detailed investigations have found that the rate at which matter is accreted is the main driver of gas outflows, while radio activity plays a smaller role. The spectra of AGNs is also used to estimate the stellar light from the host galaxy. Measuring black hole mass in low-redshift ($z \leq 0.8$) AGNs is challenging due to the contribution of stellar light from the host galaxy. An empirical relation to estimate host galaxy stellar luminosity from AGN optical spectra from Sloan Digital Sky Survey (SDSS) at $z \leq 0.8$ is estimated. Analysing data from 11,415 quasars, stellar and AGN light levels were calculated and discovered that the host galaxy's light fraction decreases as the AGN's brightness increases. This fraction also decreases with iron strength, Eddington ratio, and redshift. The new method matches results from other techniques, helping to estimate AGN brightness accurately even when the host galaxy's light is strong. **[**Ayubinia, A., Woo, J.-H., **Rakshit, S.**, Son, D. (2023). *Astrophy. Jr., 954*, 27A; Jalan, P., **Rakshit, S.**, Woo, J.-J., Kotilainen, J., Stalin, C. S. (2023). *Mon. Not. Roy. Astron. Soc. Lett., 521L*, 11J**]**.

Blazars

A blazar is a type of AGN with a relativistic jet pointed almost directly toward Earth, making it one of the brightest and most variable sources of radiation. Using more than a decade (2008–2022) of radio band data that were collected at seven different frequencies ranging from 2 to 230 GHz of the blazar 3C 279, detailed cross-correlations between multi-band observations of the radio variability were carried out. The multi-band radio light curves show variations in flux, with the prominent flare features appearing first at higher-frequency and later in lower-frequency bands, as shown in **Figure 10**. This behaviour is quantified by cross-correlation analysis, which finds that the emission at lower-frequency bands lags that at higher-frequency bands. The flux variations in conjunction with the evolution of bright moving knots seen in multi-epoch Very Long Baseline Array (VLBA) maps suggest possible physical changes in the jet that can explain the observational results. Some of the variations are consistent with the predictions of shock models, while others are better explained by a changing Doppler beaming factor as the knot trajectory bends slightly, given a small viewing angle to the jet. Multiwavelength variability is another aspect of the study of these sources.

Long-term multi-band light curves of the flat-spectrum radio quasar PKS 1510-089 observed between 2008 and 2018 by the 13.7 m radio telescope in Metsähovi Radio Observatory, the SMARTS and Steward Observatory telescopes in optical and near-infrared (NIR), and the space-based Fermi-Large Area Telescope in gamma-rays are subjected to correlation and periodicity search analyses. The gamma-ray versus optical/NIR and optical against NIR correlations among all pairings of wavelengths show zero temporal lags, however the radio radiation is preceded by both the gamma-ray and optical/NIR emissions. The unresolved core emission dominated 37 GHz light curve is investigated using the generalised Lomb-Scargle periodogram, weighted wavelet z-transform, and REDFIT techniques. The results show evidence for a quasi period of about 1540 days, though it cannot be deemed significant due to the length of the entire data set **[Krishna Mohana, A., Gupta, A. C.** et al. (2024). *Mon. Not. Roy. Astron. Soc., 527*, 6970 - 6980; Yuan, Q., Kushwaha, P., **Gupta, A., C.** et al. (2023). *Astrophy. Jr., 953*, 47**]**.

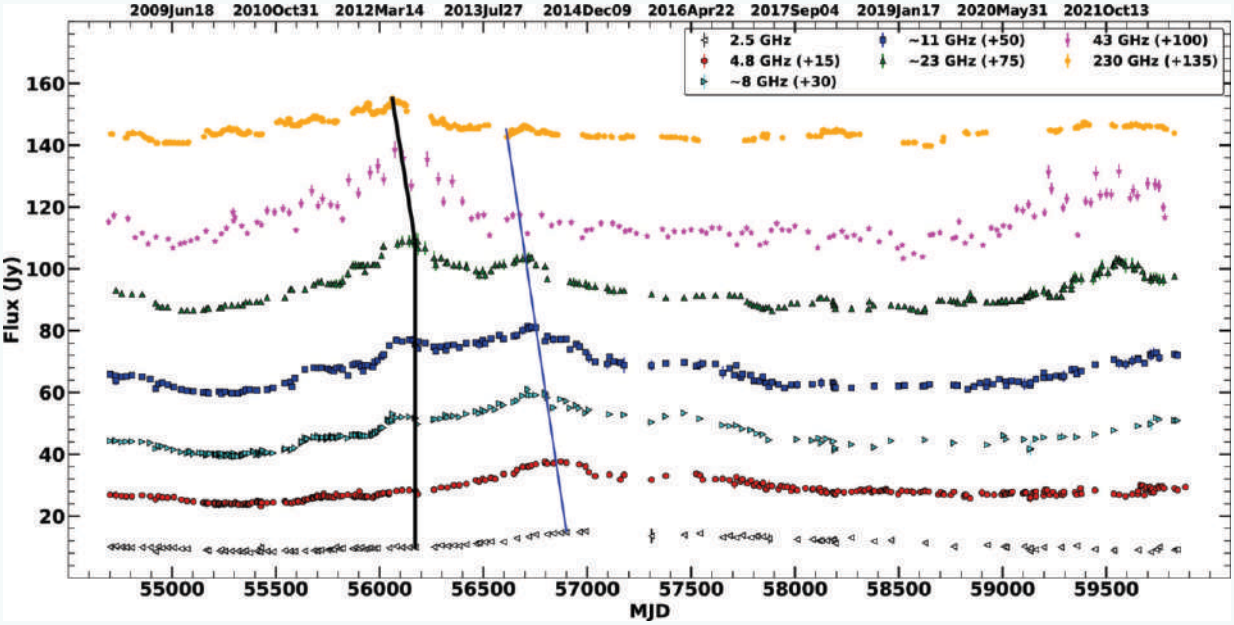


Figure 10. Multiband radio light curve of 3C 279. For clearer visual presentation, the individual light curves are shown with offsets, which are provided in the inset label. The solid black and thin blue slanted lines connect the peaks of the first and second outbursts, respectively.

Multiband optical photometric observations of the blazar S5 0716+714, conducted from November 2019 to December 2022 over 53 nights with two telescopes in Egypt, two in Bulgaria, one in Serbia, and two in India. In the B, V, R, and I bands, 1401, 689, 14726, and 165 photometric image frames were collected, respectively. Intraday flux variability was studied with single band data, and colour variation in the source can be found with quasi-simultaneous observations of two or more bands. Intraday changes with amplitudes between ~3 and ~20 percent were identified in B, V, R, and I bands in 9, 8, 31, and 3 nights out of 12, 11, 53, and 5 nights observations In another source, Blazar TXS 0506+056, multiband optical variability at different timescales was reported. This source is also a potential neutrino emitter. Using BVRI data collected over 220 nights between 21 January 2017 and 9 April 2022 from eight optical ground-based telescopes, the first comprehensive optical flux and spectrum variability studies of the TeV blazar TXS 0506 + 056 on intranight to long-term time-scales were carried out. The power enhanced F-test and the nested ANOVA test were used as two statistical analysis methods in the search for intraday variability (IDV). The source varied on 8 of the 35 nights in the R-band and in 2 of the 14 nights in the V-band, producing duty cycles (DC) of 22.8% and 14.3%, respectively. In just one of the fourteen observing nights, a distinct colour variation in V − R was observed; however, in the more restricted B, I, and B − I data, no IDV was discovered. The source varied 1.18 mag in the R-band over our observation period, and comparable changes are evident at other optical wavelengths. The blazar's optical (BVRI) SEDs were derived for 44 nights during which observations were made in each of those four wavebands as shown in **Figure 11**. It was found that the mean spectral index (α) was 0.897 ± 0.171. **[**Tripathi, T., **Gupta, A. C.** et al. (Including **Dhiman, V., Gaur, H., Kishore, S.**). 2024. *Mon. Not. Roy. Astron. Soc., 527*, 5220 - 5237; **Dhiman, V., Gupta, A. C.**, et al. (Including **Gaur, H.**). 2024. *Mon. Not. Roy. Astron. Soc., 527*, 1344 – 1356**]**.

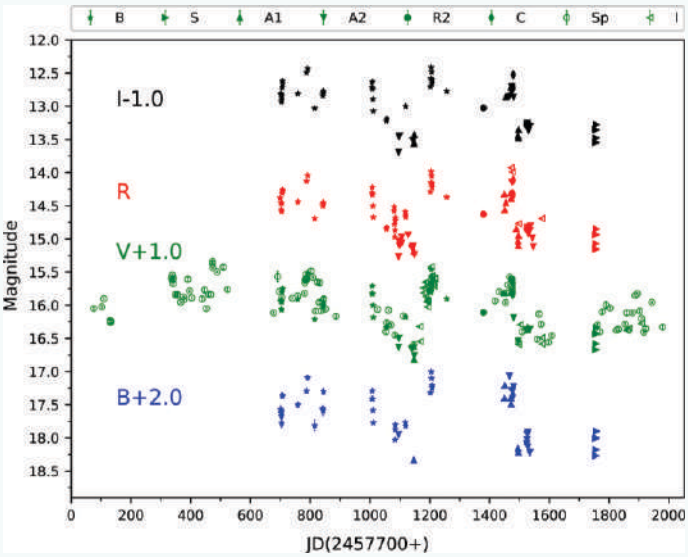


Figure 11. LTV optical (BVRI) light curves of TXS 0506 + 056. The data points are collected by various telescopes around the world. The plot legends are defined based on the particular telescope used; **B:** 60 cm Cassegrain Telescope at Astronomical Observatory Belogradchik, Bulgaria, **S:** 1.3 m Skinakas Observatory, Crete, Greece, **A1:** 1.3 m Devasthal Fast Optical Telescope (DFOT) at ARIES, Nainital, India, **A2:** 1.04 m Sampurnanand Telescope (ST), ARIES, Nainital, India, **R2:** 2 m Ritchey-Chretien telescope at National Astronomical Observatory Rozhen, Bulgaria, **C:** 0.6 m HSH classic Cassegrain at CASLEO, Argentina, **Sp:** 35.6 cm Telescope at Observatorio Astronomico Las Casqueras, Spain, **I:** 25 cm Telescope at Maritime Alps Observatory Cuneo, Italy, respectively.

In the gamma-ray light curves of these sources quasi periodic oscillations (QOPs) were detected. QPOs are variations in the radiation intensity from an astronomical object, showing nearly regular, repeating patterns over time. They are often observed in systems with accreting black holes or neutron stars and provide insights into the dynamics near compact objects. The continuous monitoring capability of Fermi-LAT has enabled the exploration of quasiperiodic oscillations (QPOs) in the gamma-ray light curve of blazars that has given a new perspective to probe these sources over a wide range of timescales. By utilising more than a decade-long Fermi-LAT gamma-ray light curves of three blazars, a persistent QPO with a period of ~100 days was detected in the blazar PKS 0346−27, whereas two blazars, namely PKS 0244-470 and 4C+38.41, showed transient QPOs with a period range of 7 to 225 days. The origin of these QPO detections were argued to be that the current-driven kink instability and curved jet model seem to be the most likely causes for shorter and longer QPOs (See **Figure 12** for its cartoon diagram). **[**Das, A., K. et al. (including **Gupta, A., C.**), 2023, *Astrophy. Jr., 950*, 173; Prince, R. et al. (including **Gupta, A., C.**). (2023). *Astron. & Astrophy, 678*, A100**]**.

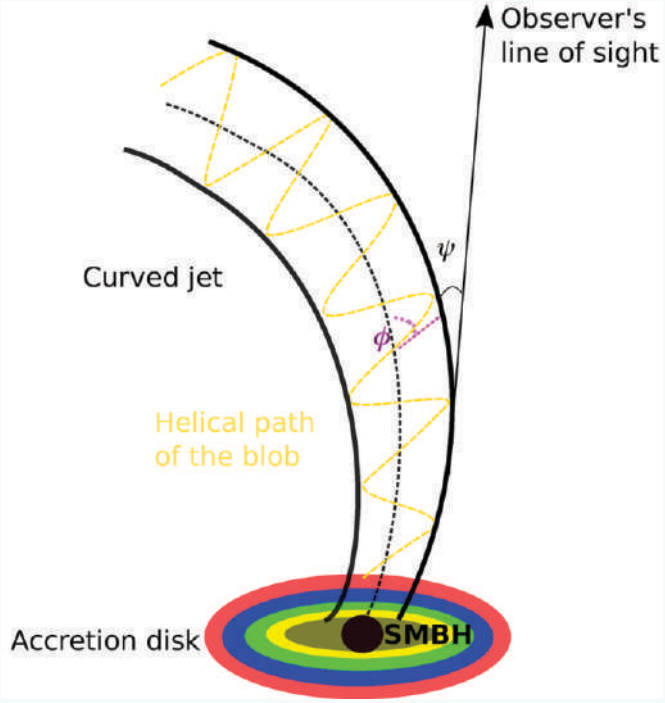


Figure 12. Possible curved-jet present in the source. The φ is the angle between the blob velocity vector and the jet axis. The ψ is the viewing angle measured between the jet axis and the observer's line of sight. Note that the accretion disk is represented by the multicolour blackbody.

In the same source, OJ 287, quasi-simultaneous optical flux and polarisation variability was also detected. In an extensive optical flux and polarisation variability study of the binary black hole blazar OJ 287 using quasi-simultaneous observations from 2015 to 2023 carried out using telescopes in the USA, Japan, Russia, Crimea, and Bulgaria. This was one of the most extensive quasi-simultaneous optical flux and polarisation variability studies of OJ 287. The blazar showed large amplitude, ~3.0 mag flux variability, large changes of ~37% in degree of polarisation, and a large swing of ~215° in the angle of the electric vector of polarisation. During the period of observation, several flares in flux were detected. Those flares were correlated with a rapid increase in the degree of polarisation and swings in the electric vector of polarisation angle. A peculiar behaviour of anti-correlation between flux and polarisation degree, accompanied by a nearly constant polarisation angle, was detected from JD 2,458,156 to JD 2,458,292. **[Gupta, A., C.** et al. (including **Gaur, H.**). (2023). *Asytophy. Jr. Lett., 957*, L11**]**.

In another Blazar OJ 287 optical flares were observed. By utilising unprecedented 2-minute sampling data, an analysis was carried out of the optical light curves of the blazar OJ 287 that were collected during a period of about 80 days,

from 13 October 2021 to 31 December 2021, using the Transiting Exoplanet Survey Satellite (TESS). Two extraordinary flares were observed around the middle of November 2021, with flux roughly doubling and then nearly tripling over two days, despite the fact that significant fluctuation has been found throughout the entire period (See **Figure 13**). In the rising phase of the initial flare, 0.38 days was determined to be the most likely shortest variability timescale. **[Kishore, S., Gupta, A., C.,** Wiita, P., J. (2024). *Astrophy. Jr., 960*, 11**]**.

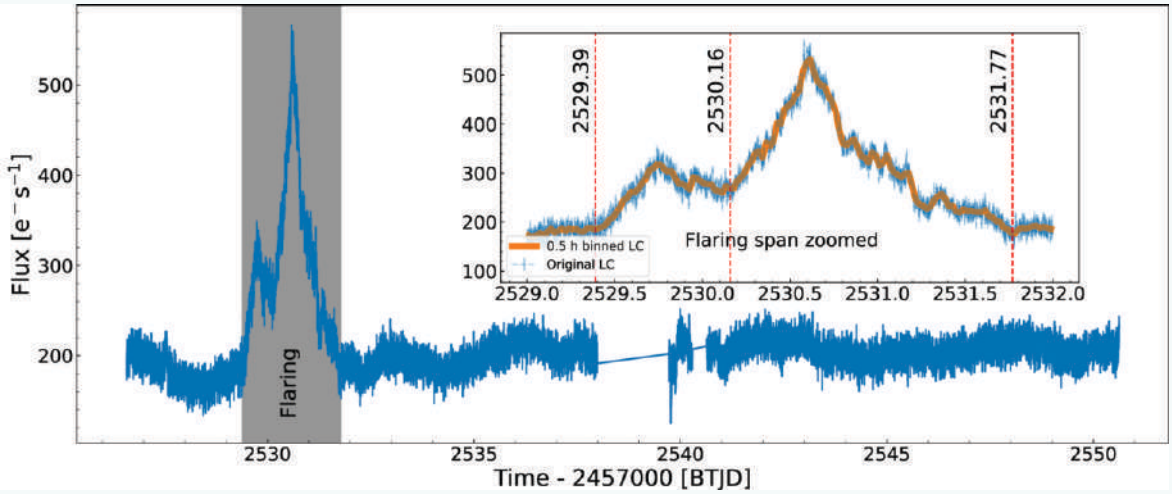


Figure 13. The main plot includes the complete reduced Sector 45 LC. The subplot zooms in on the flare period; for better visualisation of the trend, a 0.5 hr binned LC has been overplotted.

Mass of supermassive black holes

The Seoul National University AGN Monitoring Project (SAMP) conducted spectro-photometric monitoring of AGNs from 2015 to 2021, with a cadence of 20-30 days for spectroscopy and 3-5 days for photometry, resulting in high-quality multi-epoch spectra of high-luminosity AGNs. In Woo et al. (2023), for the first time, time lag measurements between Hβ emission variability and the continuum for 32 AGNs, with reliable lags for 25 AGNs were reported. This significantly expanded the sample of reverberation-mapped AGNs, particularly at moderate-to-high luminosities. The study derived a revised Hβ

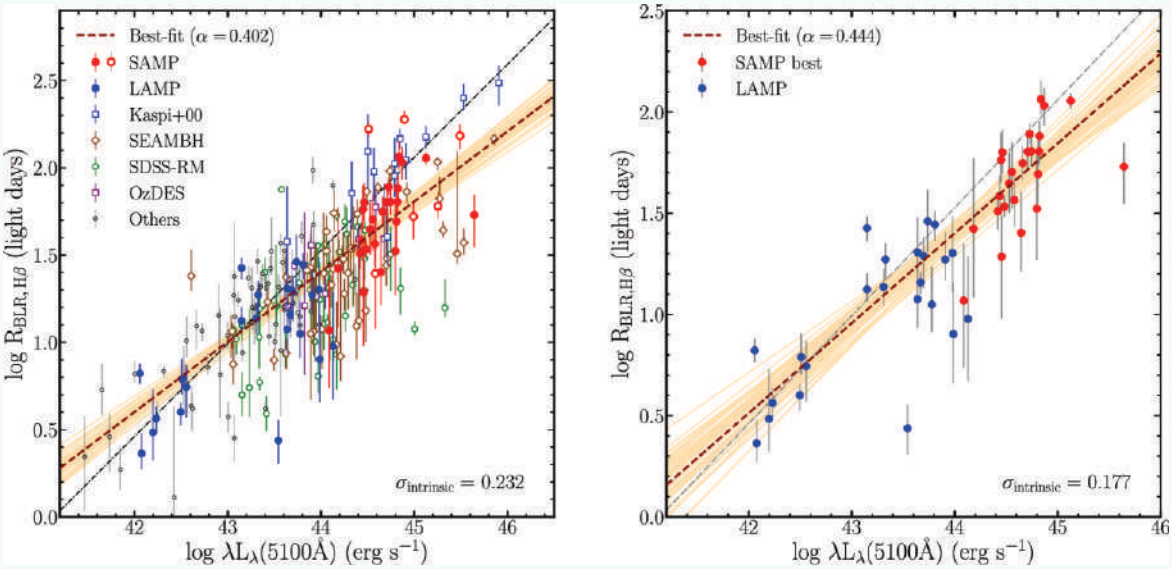


Figure 14. Left: Hβ BLR size–luminosity relation of the combined sample of SAMP (red filled and open circles) and literature measurements with the optical luminosity. The brown dashed line and the light orange lines represent the best-fit relation and 50 realizations randomly drawn from the MCMC chains. As a comparison, the best-fit slope of 0.533 from Bentz et al. (2013; gray dotted–dashed line) is denoted. **Right:** Hβ BLR size–luminosity relation based on the 24 best measurements from SAMP (red circles) and 23 measurements from LAMP (blue circles).

broadline region size-luminosity relation, showing a shallower slope than previously reported, suggesting potential inaccuracies in current single-epoch black hole mass estimators. Using six years of monitoring data, Cho et al. (2023) measured Hα lags for high-luminosity AGNs and derived size-luminosity relations for the Hα BLR. The slopes of these relations were consistent with the Hβ size-luminosity relation. The study also established a linear relationship between the 5100 Å continuum luminosity and broad Hα luminosity, as shown in **Figure 14**. A new virial mass estimator based on the Hα emission line was proposed, revealing that previous mass estimates were overestimated by up to 0.7 dex for masses below 10 million solar masses. **[**Cho, Hojin et al. (including **Rakshit, Suvendu**). (2023). *Astrophy. Jr., 953*: 142 (16pp); Woo, Jong-hak et al. (including **Rakshit, Suvendu**). (2024). *Astrophys. Jr., 962*: 67 (31pp)**]**.

Time Domain Astronomy

Gamma-Ray Bursts (GRBs) and their Properties

Short GRBs are thought to come from the merger of compact objects (NS-NS or NS-BH). In some cases, the merger of NS-NS can produce a rapidly rotating and highly magnetised millisecond magnetar. A significant proportion of the rotational energy deposited to the emerging ejecta can produce a late-time radio brightening from interacting with the ambient medium. Late-time observations are the most delayed searches for emissions from GRBs, and the detection of merger ejecta signatures can have profound implications for understanding the progenitors. Five short GRBs were observed with the GMRT ~2-11 years after the burst to search for merger ejecta signatures at a later time. No evidence of late-time emission was found in the low-frequency search. The non-detections and the magnetar

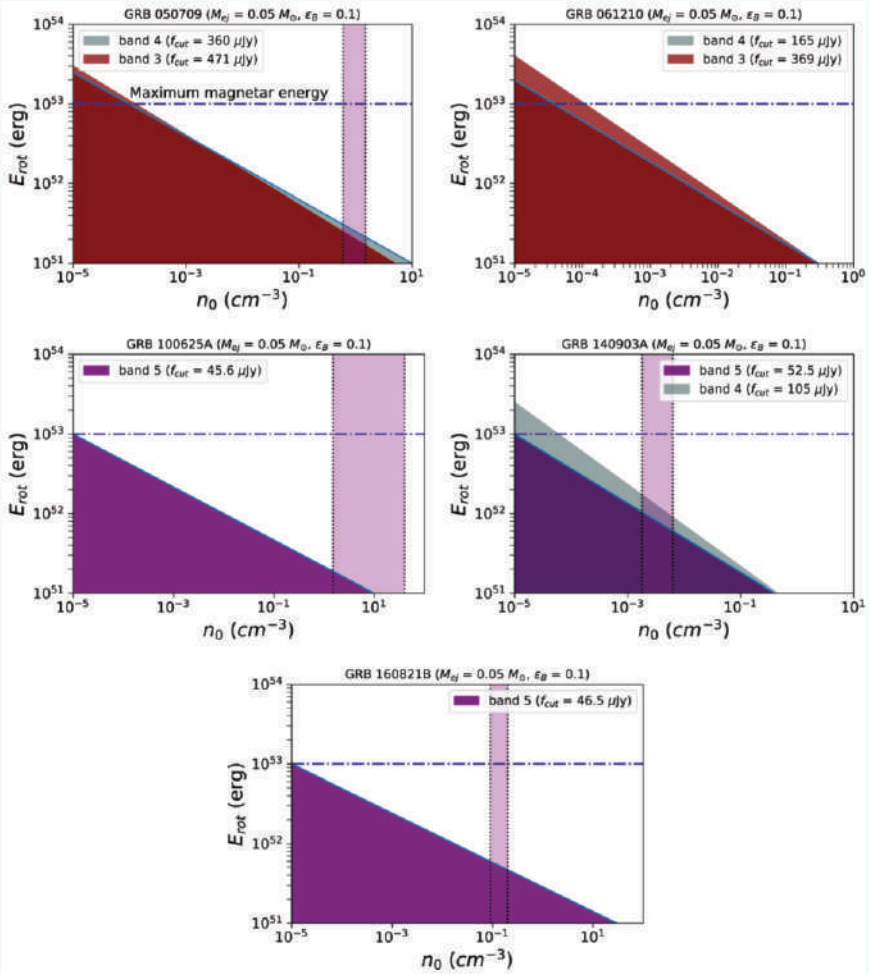


Figure 15. Rotational energy versus number density parameter space for five GRBs observed with uGMRT band 5, band 4, and legacy GMRT 610 MHz, 325 MHz, considering 3σ upper limits and observing time. The diagonal-filled spaces in these figures symbolize the allowed parameter space, whereas white space indicates the forbidden space. Dark magenta, dark slate grey, and maroon colours represent the allowed parameter space for band 5, band 4, and band 3 of GMRT, respectively. The vertical pink region indicates the 1σ span of the number density ranges from afterglow modelling. The blue dashed–dotted line represents the maximum rotational energy of a magnetar.

modelling of the radio light curves constrain the ambient number density and the maximum rotational energy of the potential magnetar. It was found that none of these GRBs were consistent with the maximally rotating magnetar with a rotational energy of $\sim 10^{53}$ erg. Rotational energy versus number density parameter space for five GRBs are shown in **Figure 15**. In future, observations with more sensitive telescopes like the Square Kilometre Array (SKA) will be able to push the limits of merger ejecta emission at late-times **[Ghosh, A.**, Vaishnava, C., S., Resmi, L, **Misra, K.**, Arun, K. G., et al. (2024). *Mon. Not. Roy. Astron. Soc., 527*, 8068**]**.

In recent years, the GRB classification has increased the interest of the transient research community. GRBs are traditionally classified as long and short based on the duration of their prompt emission, and two different progenitor channels (collapsar and mergers) are suggested. However, with the recent detections of some GRBs, this classification scheme is challenged where a long GRB association with a kilonova and one short GRB association with a supernova was found. These findings demand a more detailed classification of the GRB population. Using the prompt emission light curves of Swift GRBs and machine learning algorithms, five distinct clusters of GRBs were identified, of which kilonova associated GRBs were located in two separate clusters. This indicates that they may have been produced by different progenitors. It is also possible that subclasses of NS-NS or NS-BH mergers would have produced the two different clusters. The sub clustering shown in **Figure 16**, represents kilonova associated GRBs located in two separate clusters. Future gravitational wave observations would help understand the implications of these clusters better **[Dimple, Misra, K.**, Arun, K. G. (2023). *Astrophy. Jr. Lett., 949*, 22D**]**.

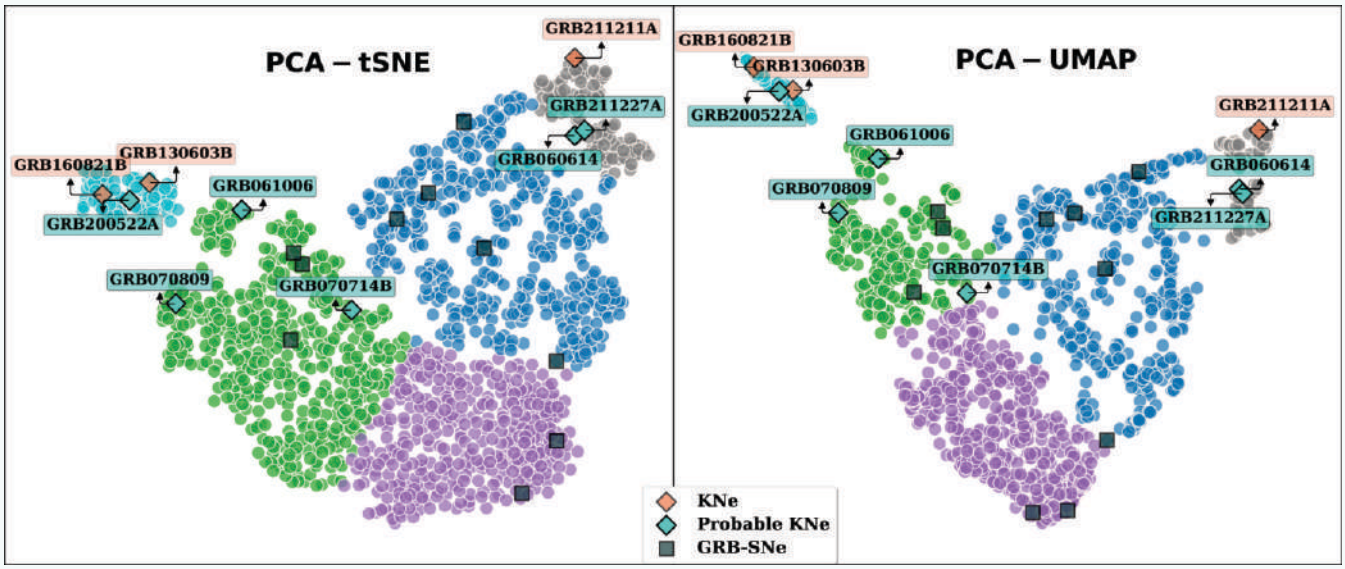


Figure 16. Left: the locations of KN-associated GRBs on a two-dimensional embedding obtained using PCA-tSNE. The coral-coloured labels represent the GRBs with confirmed KN association. The turquoise-coloured labels are the GRBs with probable KN candidates. The KN-associated GRBs with long and short duration occupy two locations on the embedding (right and left corners). The filled-grey squares show the location of GRB-SNe on the embedding. **Right:** same using PCA-UMAP. The embeddings are colour coded with respect to the five clusters identified by AutoGMM.

In recent years GeV-TeV gamma-rays have been discovered from GRB afterglows. Their origin and physical mechanism was investigated in GRB 180720B and GRB 190829A with an external Compton (EC) scenario. The study focused on the role of EC scattering, where low-energy photons are up-scattered by relativistic electrons, contributing to the observed VHE gamma-ray spectra. By analysing the observational data and theoretical models, the study aimed to understand the physical conditions and emission processes in these GRBs, shedding light on the nature of VHE gamma-ray production in such extreme astrophysical events. **[**Barnard, Monica, Razzaque, Soebur & **Joshi, Jagdish C.** (2024). *Mon. Not. Roy. Astron. Soc., 527*, 11893–11899**]**.

Observational Properties of Supernovae

Type Iax supernovae are the low luminosity and less energetic cousins of the type Ia supernovae. The diversity in the observed properties, such as peak brightness, light curve decline rates, and ejecta velocities, indicates that type Iax supernovae form a heterogeneous class. A combined study

of the bright and faint type Iax SNe revealed that the brighter objects tend to have a longer rise time. However, the correlation between the peak luminosity and decline rate showed that bright and faint type Iax SNe exhibit distinct behaviour. Correlation between the absolute magnitude and light-curve decline rates is shown in the top panel of **Figure 17**. The bottom panel represents the rise time and absolute magnitude for a sample of well-studied Type Iax Sne.

A comparison with standard deflagration models suggests that they are consistent with either the deflagration of a CO white dwarf or the deflagration of a hybrid CONe white dwarf. The spectral modelling indicates stratification at the outer layers and mixed inner ejecta. Further, Bridging between Type IIb and Ib Supernovae was also investigated. [Singh, Mridweeka et al. (including **Misra, Kuntal**). (2023). *Astrophy. Jr., 953*: 93 (14pp)].

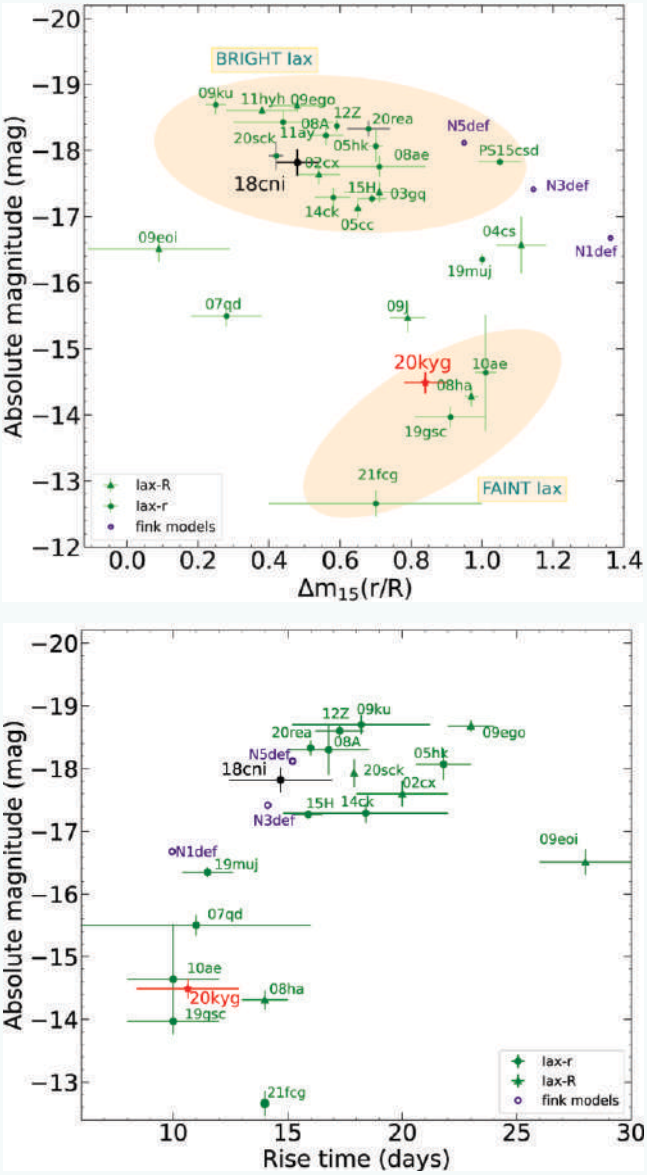


Figure 17. Top: Absolute magnitude vs. light-curve decline rate in r/R-band for well-studied Type Iax SNe. **Bottom:** Distribution of Type Iax SNe in terms of the peak absolute magnitude and rise time in r/R-band. The figure clearly depicts the fact that Type Iax SNe follow a correlation in their peak luminosity and rise time.

Numerical and Theoretical Astrophysics

In this research area relativistic flows around the compact objects are investigated using numerical simulations and semi analytical models. The group also investigates the origin of cosmic rays and multimessenger connections of the astrophysical sources.

Relativistic Flows around Black Holes: Accretion and Jets

As a physical process, accretion onto a black hole is a convergent flow, which implies that matter speeds up as it falls through the gravitational potential of the central object, and simultaneously it gets hotter and denser except very close to the horizon. While jets originate from the inner regions of the accretion disc and are hot, but expands supersonically and sometimes at relativistic speeds into the ambient medium and becomes less dense and colder as it gains speed and therefore is a divergent flow. Various aspects of the accretion and ejection phenomena around compact objects were investigated as described below.

Effect of composition on Jet morphology

The special relativistic simulation code with Chattopadhyay -Ryu equation of state, was used to study the effect of composition in influencing the morphology of jets. It was found that contrary to expectations, the jet morphology does depend on the composition. Density contours of a jet model are shown in **Figure 18**. The electron-positron pair jets are the least relativistic while electron proton jets are not the most. Jets with proton proportions between 20-50% of the electron number density is the most relativistic depending on whether the jets are launched with same injection speed, or same Mach number or the same jet kinetic luminosity **[Joshi, Raj Kishor & Chattopadhyay, Indranil**. (2023). *Astrophy. Jr., 948*: 13(10pp)**]**.

Numerical simulation of viscous accretion discs and explanation of QPOs by oscillating shocks

Simulation code with Paczynskii Wiita pseudo potential but using the Chattopadhyay-Ryu equation of state was used to study viscous accretion flows onto black holes in presence of viscosity. All the analytical accretions solutions obtained in

Kumar & Chattopadhyay 2014 were regenerated. It was found that oscillating shocks can explain the QPOs seen in the accreting blackholes, where the fundamental frequency of the oscillation of the hard radiation matches with the frequency of the oscillating shock. The obtained frequencies range from <1Hz to 10 Hz, for a ten solar mass black hole. The results of these numerical simulations are also shown in **Figure 19**. **[Debnath, Sanjit, Chattopadhyay, Indranil & Joshi, Raj Kishor**. (2024). *Mon. Not. Roy. Astron. Soc., 528*, 3964-3980**]**.

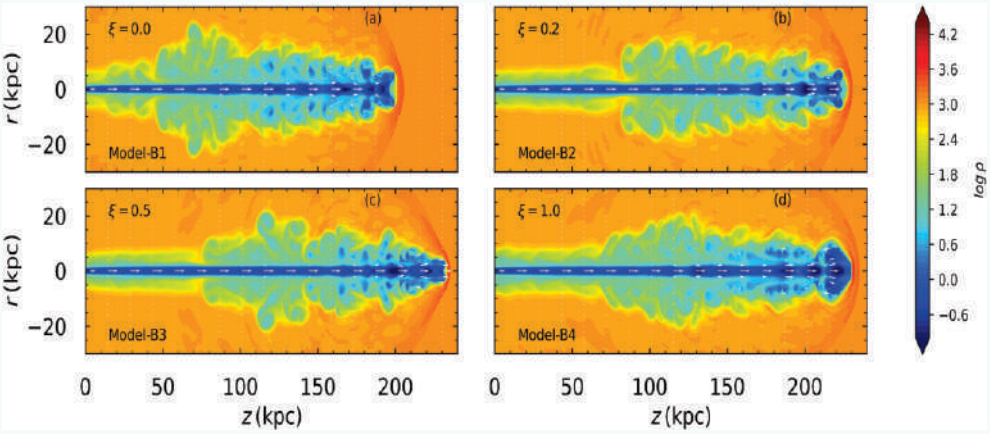


Figure 18. Density contours of a jet models injected with the same jet kinetic luminosity $L_{jet}=4.92\times10^{45}$ erg/s, expanding to an ambient medium of the same density and enthalpy, each model difers in jet composition B1 is ξ=0.0 (pair plasma), B2 is ξ=0.2 (20% protons), B3 is ξ=0.5 (50% protons) and B4 is ξ=1.0 (electron-proton).

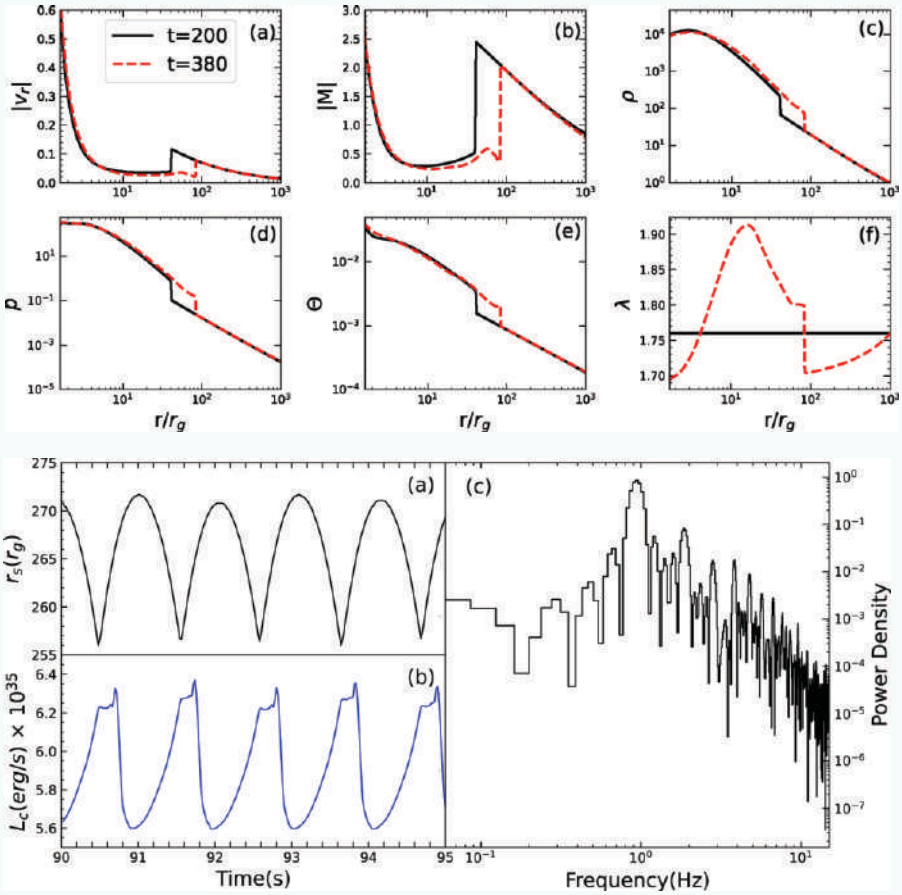


Figure 19. Top: (a) Radial infall velocity v_r, (b) Mach number of v_r, M, (c) density ρ, (d) pressure p, (e) $\Theta = p/(\rho c^{2})$ and (f) specific angular momentum λas a function of r for viscosity parameter α=0.035. Injection parameters r_{ou}=1000, v_{ou}=-0.01348, $\Theta_{ou}=1.912\times10^{-4}$, and λ_{ou}=1.76 in geometric units.] **Bottom:** (a) Variation of shock position with time (in seconds), (b) Variation of total luminosity (erg s^{-1}) with time, (c) Power density spectrum (PDS) α=0.02. The BH mass is 10 Msun.

Two temperature solution of strongly magnetised compact star and emergent spectra

For strongly magnetised stars, matter accretes following a disc-like structure till a location where magnetic pressure balances gas and ram pressure of the accreting matter, see the cartoon diagram in **Figure 20**. Thereafter it follows the field lines onto the poles of the stars. However, since the accreting matter along the field lines becomes supersonic, infall times scales are shorter than electron and proton relaxation times scale. Protons and electrons relax into two temperature distribution, the so called two temperature regime. Unfortunately, two temperature regime is degenerate, i. e., admits a large number of solutions for a given set of constants of motions. By measuring the entropy of these solutions, the one with the maximum entropy was proposed as the physical solution and corresponding spectra was obtained as a function of the magnetic field, spin period and accretion rate on to the star. A primary shock was always formed just near the surface. For a certain range of flow parameters secondary shocks were also present and showed as an extended high energy tail in spectra of continuum emission **[Sarkar, Shilpa, Singh, Kuldeep, Chattopadhyay, Indranil**, & Laurent, Philippe. (2023). *Mon. Not. Roy. Astron. Soc., 522*, 3735–3752**]**.

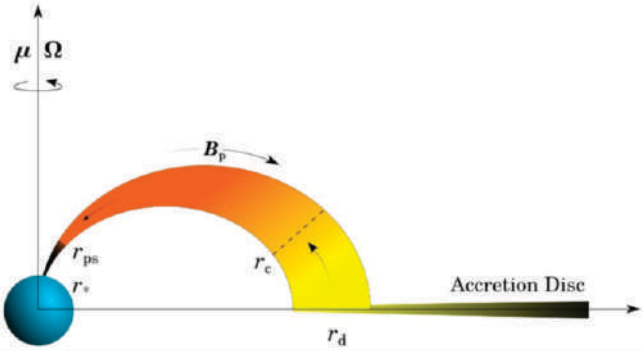


Figure 20. Cartoon diagram of the accretion geometry around a magnetized compact object.

Searching Galactic PeVatrons via Multi Messenger Connections

Galactic PeVatrons are plausible astrophysical sources within the Milky Way capable of accelerating cosmic rays to peta-electronvolt (PeV) energies, which are among the highest energies observed in cosmic rays. PeVatrons could include supernova remnants, pulsar wind nebulae, but their exact nature remains unknown. Observations of gamma rays, particularly in the TeV to PeV range, is useful to reveal the nature of these sources. The potential PeVatrons sources within our galaxy were studied by using data from the Large High Altitude Air Shower Observatory (LHAASO) and the correlation between observed gamma rays and neutrinos was examined. Two of the supernova remnants, SNR G106.3+2.7, SNR G40.5–0.5 were found to be potential sources of cosmic rays. In the standard diffusive shock acceleration theory, cosmic rays follow a power-law spectrum. The spectral index value is approximately 2 or takes a greater value, however, for these two sources, the detected TeV-PeV gamma-ray spectra are found to be unusually hard (with spectral index ~ 1.8).

The gamma-ray emissions from giant molecular clouds (GMCs) in our Galaxy in the GeV-TeV energy range were explored. These GMC were located in the Gould Belt and the Aquila Rift regions in the Milky Way. The gas density in the GMCs provides a good target medium for the interactions of the cosmic rays. One of the intimate sources of cosmic rays in these GMCs might hide inside, such as T-Tauri stars. Some of the literature suggests that several 100 T-Tauri stars in GMC environments could inject an extra component of CRs that, interacting with the gas medium, can produce additional gamma rays. Using a detailed interaction approach by utilising the GEANT4 simulation toolkit galactic cosmic ray interactions with the GMCs were investigated. This is used to constrain the gas density profile inside these GMC and found that an inverse square law of density can be used for the interpretation of the GeV-TeV gamma rays. In **Figure 21**, the gamma-ray spectrum of Aquila Rift molecular cloud is shown and the potential contribution of p-p interaction is also plotted against the currently available observations. **[**Sarmah, P., Chakraborty, S. & **Joshi, Jagdish C.** (2023). *Mon. Not. Roy. Astron. Soc., 521*, 1144–1151.; **Roy, Abhijit**, **Joshi, Jagdish C.** et al. (2024). *Jr. Cosmo. Astropart. Phys., 2024*: 6 (32 pp)**]**.

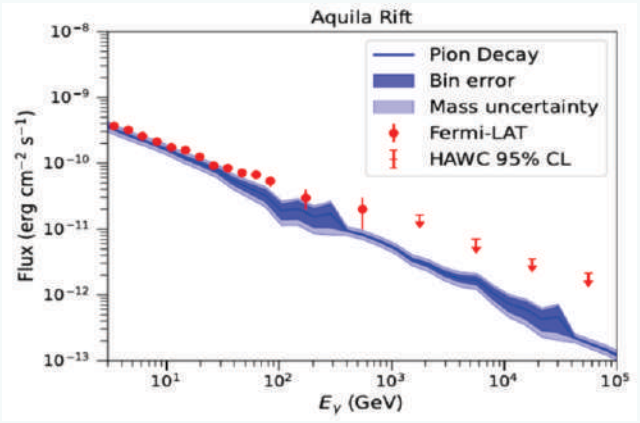


Figure 21. Comparison of the simulated gamma-rays from the Aquila Rift in GeV-PeV range. The GeV-TeV data is from the Fermi-LAT satellite and the upper limits (95% confidence level upper limits) estimated by the High-Altitude Water Cherenkov Gamma-Ray Observatory.

The Sun and the Solar System

The Sun being our closest star allows us to study the stellar activity and dynamics in great detail. The solar physics group at ARIES conducts research to probe different regions of the Sun spanning from the solar interior to the extended outer atmosphere. Specific research areas of interest include the differential rotation of the Sun, observations of magnetohydrodynamic (MHD) waves, solar atmospheric seismology, and the CME kinematics.

Statistical investigation of decayless oscillations in small-scale coronal loops

MHD kink waves sustaining for multiple cycles, known as decayless oscillations, have been found to be ubiquitous in active region large loops. These waves are crucial, as their dissipation in the solar corona can provide the necessary energy to counteract radiative losses. However, so far, the small-scale loops have not been explored widely in the context of decayless waves. Using high-resolution imaging observations (pixel scale ≅100-200 km) from the Extreme Ultraviolet Imager (EUI) onboard Solar Orbiter, decayless waves in short loops were detected for the first time in a quiet Sun region and a coronal hole. It has been known that the decayless waves in large-scale loops tend to show a linear relationship between the loop length and oscillation period, indicating their standing nature. But, surprisingly, no such correlation was found in the oscillations found in short-scale loops. This is mainly due to the presence of longer period waves, which manifests as a second branch in loop length vs period relation plot (see **Figure 22**). Additionally, it was found that the energy flux in these waves is not sufficient to compensate for the energy losses in quiet Sun and coronal holes.

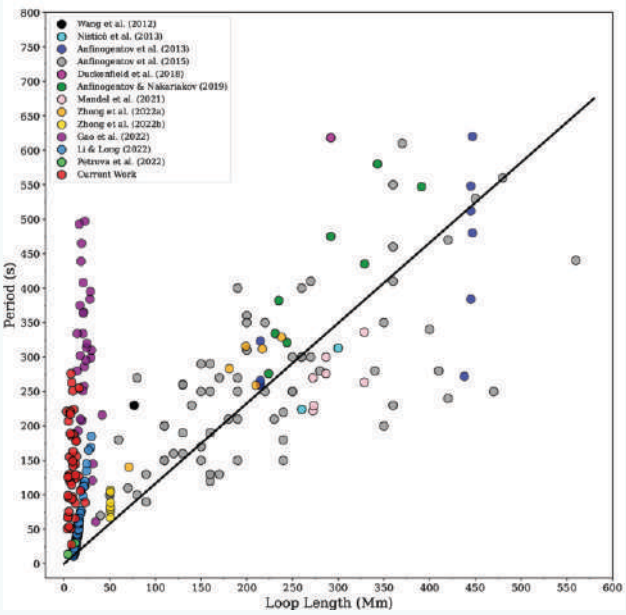


Figure 22. Scaling between the loop length and the period. The figure shows the variation in the loop length vs period of the decayless oscillations analysed in the present and previous studies. A notable presence of the second branch for small-scale loops is visible.

This investigation of small-scale loops uncovered the cross-scale nature of decayless waves, offering deeper insights into their driving mechanisms and imposing constraints on coronal seismology techniques. **[Shrivastav, Arpit Kumar & Pant, Vaibhav** et al. (including **Banerjee, Dipankar**). (2024). *Astron. & Astrophys., 685*: A36 (11 pp)**]**.

Multi-thermal (apparent) damping of slow waves

There has been evidence to show that solar coronal loops at the current instrument resolution limit possess multi-thermal substructure. The large conductivity parallel to the magnetic field in corona means different temperature plasma is distributed into sub-resolution strands leading to a multi-thermal cross section. The main goal of this work is to study the effect of this multi-thermal structure within a coronal loop on the damping of propagating slow magnetoacoustic waves. Analytical calculations were performed in this regard and the results are compared with those obtained from a 3D MHD numerical simulation. The temperature distribution of the plasma within different strands was assumed to be Gaussian. Perturbations in the form of delta pulses, Gaussian pulses, and pure sinusoidal waves were considered to drive the compressive waves in the loop. In all cases, as the waves propagate, they appear to rapidly damp even though the model has no dissipative terms. This is because of the difference in propagation speed of waves in individual strands which leads to different phases at a particular height. This mixing of different phases gives an impression of damping despite no real dissipation of waves being present. It is called as the Multi-thermal Apparent Damping (MAD). Additionally, the influence of finite filter bandpasses was considered in imaging observations. This allowed forward modelling of the results and estimation of the expected propagation speed and damping length in different filters. Overall, it was found that the parameters estimated from this model are comparable to those observed in simulations.

An important take-home message of this work is that MAD is stronger than the real dissipation due to thermal conduction, particularly at shorter periods (< 200 s). These results show the potential in using the observed wave

parameters to probe the multi-thermal structure of coronal loops. Future prospects of this work include identifying the damping of slow waves due to a combined effect from thermal conduction and apparent phase mixing, which could perhaps explain the observed rapid damping in slow waves. **[**Van Doorsselaere, T., **Krishna Prasad, S., Pant, V., Banerjee, D.** & Hood, A. (2024). *Astron. & Astrophys., 683*: A109 (9 pp)**]**.

Global Coronal Magnetic Field Estimation Using Bayesian Inference

The magnetic field of the solar corona is essential to study because it offers valuable insights into the physical processes occurring over various time and spatial scales. However, measuring the magnetic field directly using the Zeeman effect is challenging due to the corona's low density and high temperature. Coronal seismology on the other hand provides an alternative method for its estimation. The technique involves combining observational data with the theoretical properties of magnetohydrodynamic (MHD) waves. In our study, we used data from the ground-based Coronal Multichannel Polarimeter (CoMP), which observes the solar corona at a temperature of 1.6 million Kelvin (MK), to estimate the coronal magnetic field. The observations cover the region from 1.05 to 1.35 solar radii. Traditionally, exact values of the plasma density are used in such estimations. However, given the dynamic nature of the corona, it was more appropriate to consider a range of density values rather than relying solely on exact ones. Different probability values were assigned to the density and magnetic field to achieve a more accurate estimate. This approach, known as Bayesian inference, refines parameter estimates as new information is incorporated. For the analysis, different distributions of possible density and magnetic field values were tried, which allowed determination of a range of probable magnetic field strengths **(Figure 23)**. It was found that the most probable values of the magnetic field diverged from those obtained using exact density values, particularly in regions where the density estimates carried significant uncertainty. This observation showed that precise density measurements are critical for accurately determining the magnetic field. **[Baweja, Upasna, Pant, Vaibhav** & Arregui, Iñigo. (2024). *Astrophys. Jr., 963*: 69 (18pp)**]**.

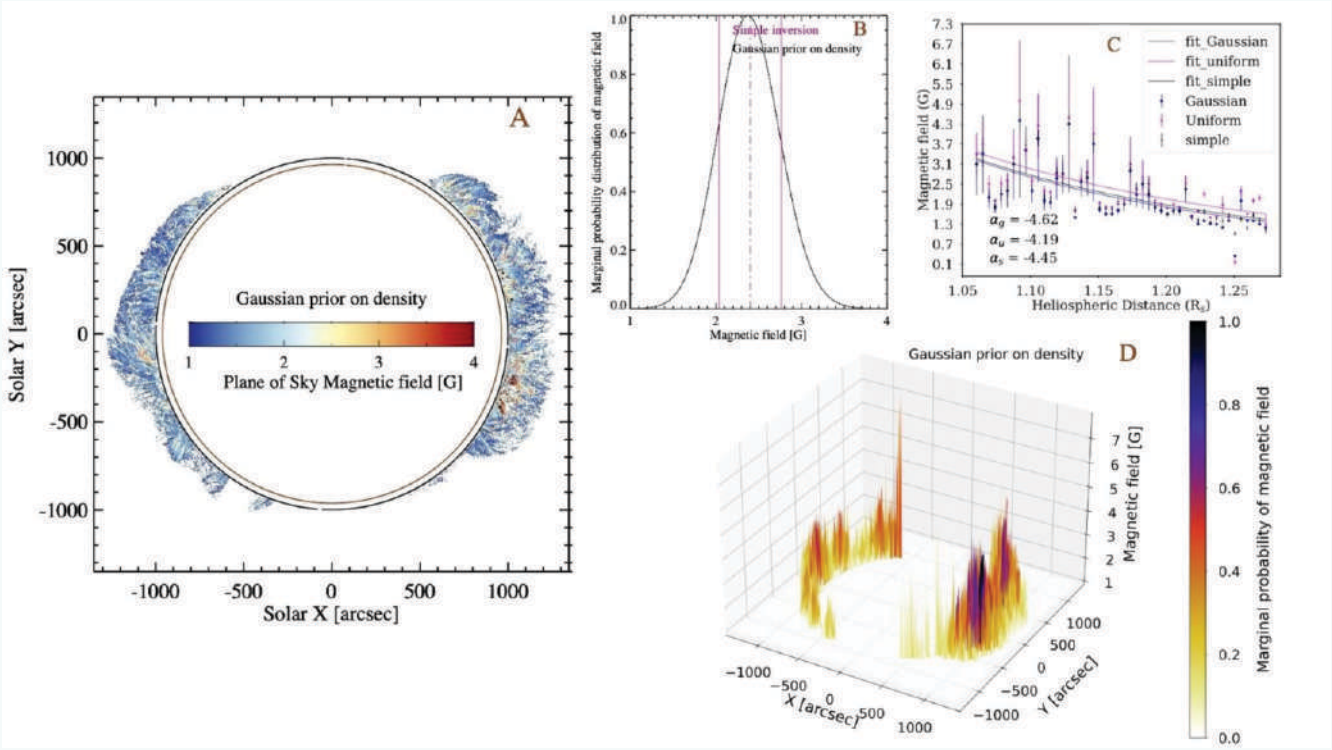


Figure 23. (A) Map of plane-of-sky component of the coronal magnetic field obtained using Coronal seismology. The inner brown circle marks the edge of the solar disc (solar limb), and the black dashed circle indicates the inner boundary of the CoMP Field of view. (B) The marginal probability distribution of the magnetic field at one location in the FOV obtained using Bayesian Inference. It gives the probability of each magnetic field value. (C) Variation of average coronal magnetic field strength as a function of radial distance from the solar centre for different priors used in the analysis. (D) The coronal magnetic field map obtained using the Bayesian inference. The height of each bar at each location represents the probable values of the magnetic field at each location.

Differential Rotation of the Solar Chromosphere: A Century-long Perspective

The rotation of the Sun is not uniform with faster rotation near the equator and slower rotation near poles, which is a well known phenomenon called differential rotation. In this study, newly calibrated multidecadal Ca II K spectroheliograms (1907–2007) from the Kodaikanal Solar Observatory (KoSO) were analysed to investigate chromospheric differential rotation using the image cross-correlation technique **(Figure 24)**. Chromospheric differential rotation plays a crucial role in understanding the atmospheric coupling between the chromosphere and the photosphere across different phases of the solar cycle. The findings revealed a chromospheric differential rotation rate described by $\Omega(\theta) = (14.61 \pm 0.04) - (2.18 \pm 0.37)$ day^{-1}. These results indicated that chromospheric plages exhibit an equatorial rotation rate that is 1.59% faster than that of the photosphere compared to the differential rotation rate derived from sunspots. Moreover, the latitudinal gradient was smaller than that observed in sunspots. To validate the results, the same method was applied to a small sample of Ca II K data from the PSPT/Rome, Meudon, and Mount Wilson observatories, all of which corroborated the findings from the KoSO data. Furthermore, no significant north-south asymmetry or systematic variation in chromospheric differential rotation was observed over the past century. **[Mishra, Dibya Kirti & Routh, Srinjana** (including **Banerjee, Dipankar**). (2024). *Astrophys. Jr., 961*: 40 (11pp)**]**.

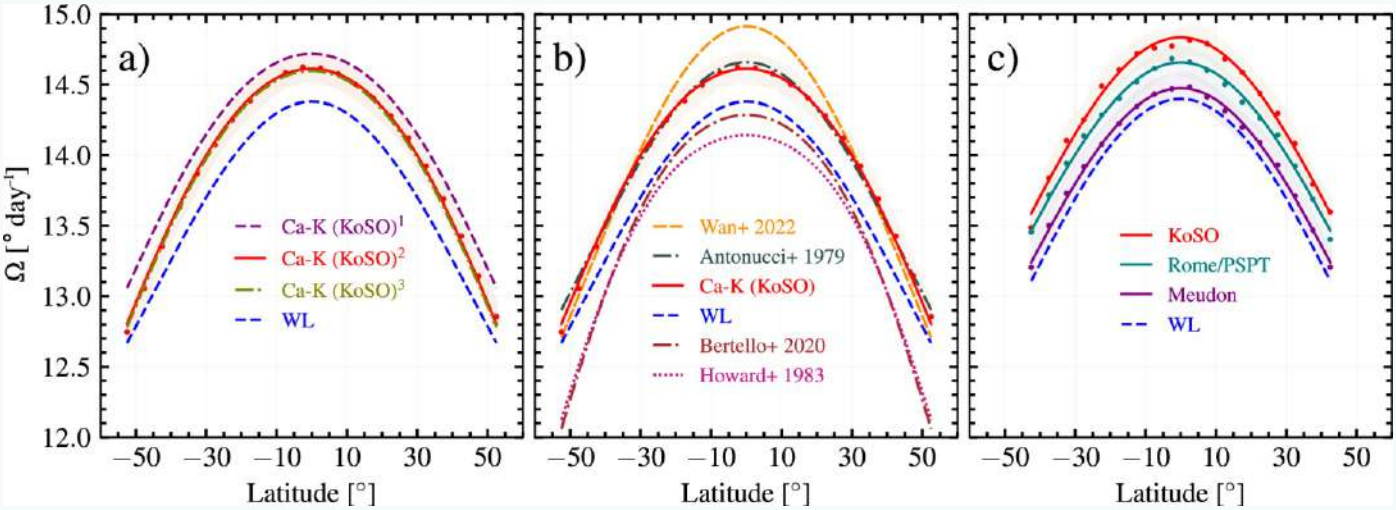


Figure 24. (a) The average rotation rate of the entire data period (1907–2007). The dashed blue curve is the rotation profile of the photosphere using sunspot (Jha et al. 2021). (b) Comparison between our results for KoSO data for the entire period and selected works from the literature. (c) A comparison between the resulting rotation profile of the chromosphere derived from different sources of Ca II K data over 2000–2002.

Exploring the impact of imaging cadence on inferring CME kinematics

Understanding the motion of coronal mass ejections (CMEs) is essential for predicting their effects on Earth and other planets, as well as gaining insights into their origin. In most cases, the acceleration and deceleration of a CME occurs below 4 $R_\odot$, making this phase critical to understanding their initiation. In particular, the behaviour of a CME in the inner corona (less than 3 $R_\odot$) strongly influences their propagation through the outer corona and their eventual impact. Given that CME dynamics is typically observed using coronagraph data, it is important to assess how the cadence of an observing coronagraph (i.e., how frequently one observes) affects data accuracy and the conclusions drawn from it, as well as its role in shaping observation strategies with future coronagraphs. This study evaluated how imaging cadence impacts the kinematics of ten CMEs tracked by the K-Coronagraph at the Mauna Loa Solar Observatory. CMEs were manually tracked using high cadence (15 s) white-light images, following which the cadence was deliberately lowered to create the 30 s, 1, 2, and 5 minute datasets to study its effect in inferring the CME kinematics. A bootstrapping method was used to estimate the confidence intervals of the obtained parameters. The findings showed that CME velocity is relatively unaffected by imaging cadence **(Figure 25)**, while acceleration is significantly influenced **(Figure 26)**, with confidence intervals varying notably across different cadences. Additionally, it was found that the cadence also impacts the estimation of the onset of acceleration. Determining the ideal imaging cadence for CME studies is challenging, as it depends on both the

instrument's pixel resolution and the CME's speed. However, for most CMEs (except those with speeds below 300 km/s), a 1-minute cadence appears reasonable for capturing their motion. These results are valuable for planning observation strategies for both current and upcoming missions targeting the inner corona. **[Vashishtha, Nitin, Majumdar, Satabdwa, Patel, Ritesh, Pant, Vaibhav** and **Banerjee, Dipankar.** (2023). *Front. Astron. Space Sci., 10*: 1232197 (14pp)**]**.

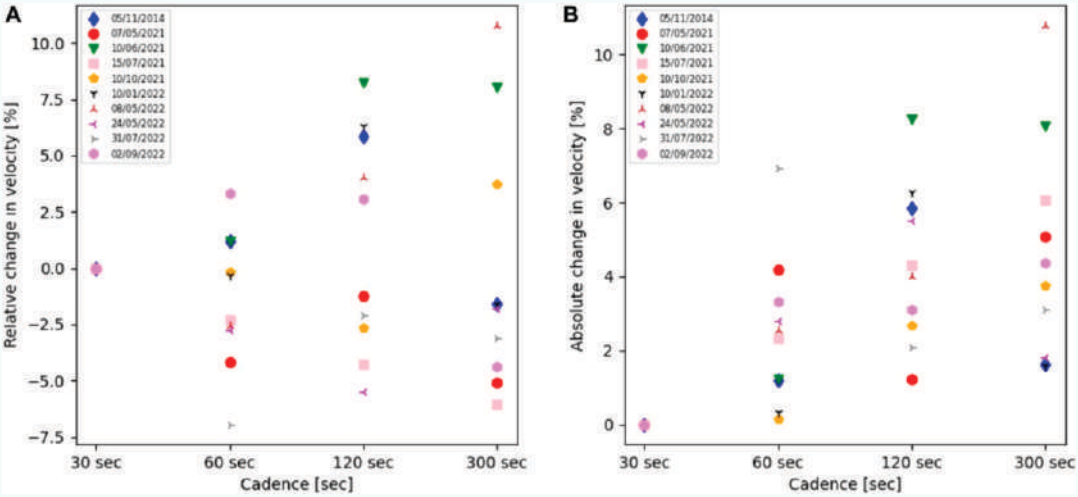


Figure 25. The (A) relative and (B) absolute changes in the velocity of each CME with respect to their 30 s cadence values.

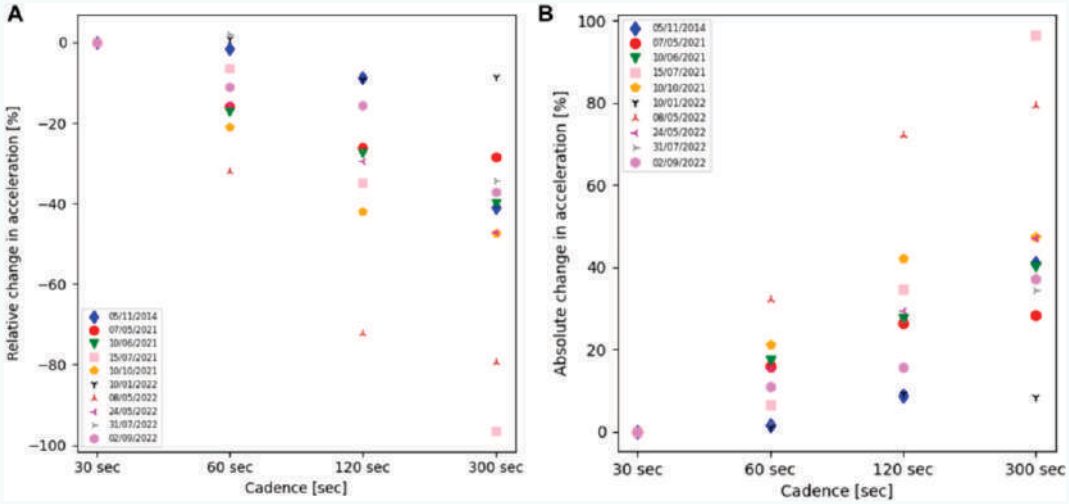


Figure 26. (A) relative and (B) absolute changes in the acceleration of each CME with respect to their 30 s cadence values.

Creation of a CME Source Region Catalogue

A source region catalogue of 3327 CMEs from 1998 to 2017 capturing the different phases of cycles 23 and 24 was created. It was used to probe the influence of the source regions on the different statistical properties of CMEs. The identified source regions were segregated into three classes—active regions, prominence eruptions, and active prominences—while the CMEs were segregated into slow and fast groups, based on their average projected speeds. The contributions of these three source region types to the occurrences of slow and fast CMEs was found to be different in the above period. The distribution of the average speeds revealed different power laws for CMEs originating from different sources as well as for different phases of cycles 23 and 24. The statistical latitudinal deflections showed equatorward deflections, while the magnitudes of the deflections again bore imprints of the source regions. The results showed that different aspects of CME kinematics bear strong imprints of the source regions they originate from, thus indicating the existence of different ejection and/or propagation mechanisms of these CMEs **(Figure 27)**. The catalogue has been made available openly through the Aditya-L1 Support Cell (AL1SC) website. [**Majumdar, Satabdwa, Patel, Ritesh, Pant, Vaibhav, Banerjee, Dipankar** et al. (2023). *Astrophys. Jr. Suppl. Series, 268*, 38 (23pp)**]**.

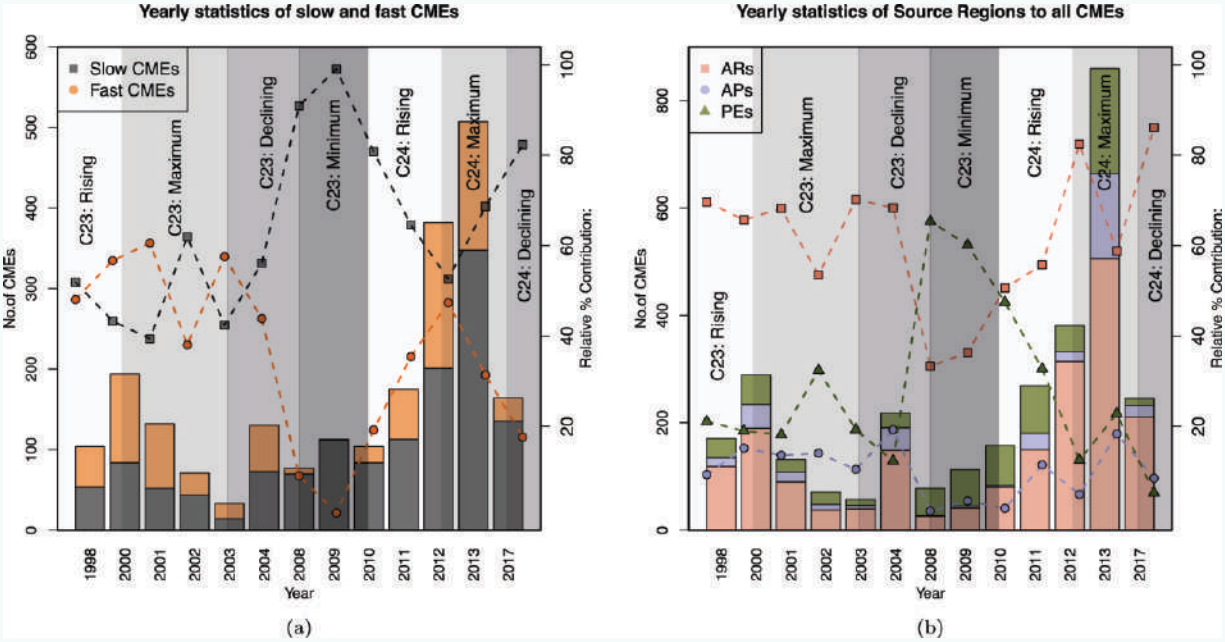


Figure 27. Yearly contributions of the source regions to (a) slow CMEs and (b) fast CMEs. The histograms are colour-coded according to the category they are representing. The left side y-axis denotes the number of events that the histograms are representing. The relative contribution of each category in each year (with respect to the total number of events in that particular year) is shown on the right side y-axis, corresponding to the data points connected by dotted lines. Different phases of the solar cycles are highlighted in the background in different shades.

North American Total Solar Eclipse Expedition

A team from ARIES has planned to conduct a scientific experiment during the Total Solar Eclipse of 8 April, 2024 visible from the North American region. The main goal of this expedition is to observe the inner solar corona using a narrowband green line filter (central wavelength 530.3 nm) in order to study the high-frequency dynamics in this region. Utilising the 14-cm Vixen telescope and the Princeton ProEM 1k × 1k detector available within ARIES, a number of test runs were carried out by the team in preparation of the expedition. During one such test run carried out to identify the optimal exposure time, imaging of the full moon was done. The complete telescope setup and a sample image of the full moon captured during this run are shown in **Figure 28**.

Figure 28. Left: 14-cm Vixen telescope with green line filter and CCD mounted for a test run at ARIES. **Right:** Sample image of the full moon captured around midnight during one of the exposure test runs.

Atmospheric Sciences

Aerosols and Meteorology

Assessing the high-resolution PM2.5 measurements over a Central Himalayan site: impact of mountain meteorology and episodic events.

The contribution of fine and coarse mode particles (PM2.5/PM10) and their natural and anthropogenic sources during two specific events of dust storm and fire event were estimated using MERRA-2 hourly data of assimilated aerosol diagnostics. The selected period encompassed approximately 2 weeks before and after the events to capture the relevant changes. It was revealed that the reanalysed data provided a better representation of dust episodes as compared to fire events, with a decrease in the role of coarse mode particles from 0.43 to 0.24 during the first case. Following the next event, fine-mode particles dominated the site. For a longer period of crop residue burning (CRB) event, the data did not exhibit precise variability. However, there was a significant increase in the PM2.5/PM10 ratio, reaching up to 0.83, indicating a higher fraction of fine mode particles compared to other intervals of the year **(**top panel of **Figure 29)**.

Relative changes for different natural aerosols (dust-DU, sea salt-SS) and anthropogenic aerosols (sulphate-SO4, organic carbon-OC, black carbon-BC) using yearly mean values within a 2-week timeframe before and after the events were also calculated. During the dust event, dust and sea salt concentrations exhibited remarkably higher changes, approximately 5 and 8 times, respectively. This aligns with their dominant contributions during this season. In contrast, during the CRB event, sea salt concentration experienced a 70% decrease, while dust concentration nominally increased. As for the anthropogenic sources, sulphate showed a minimal decrease compared to organic carbon (40%) and black carbon (~30%) during the dust event. However, there was a substantial increase in sulphate (90%), followed by organic carbon (55%) and black carbon (50%) during the winter season **(**bottom panel of **Figure 29)**, despite their values decreasing slightly in the two weeks prior **[Rawat, Vikas, Singh, Narendra, Singh, Jaydeep, Rajput, Akanksha** et al. (2024). *Air Qual. Atmos. Health, 17*: 51 (20 pp)**]**.

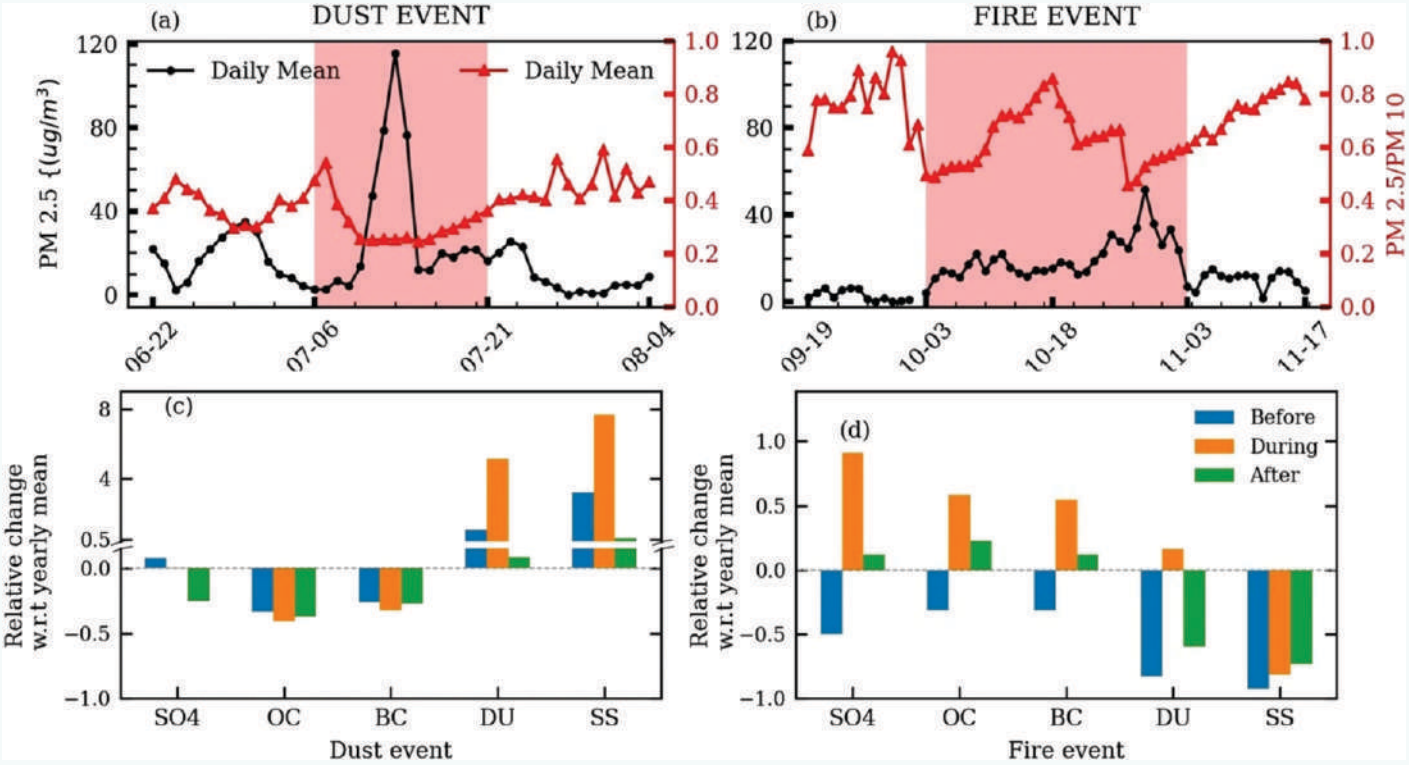


Figure 29. The temporal variations of PM2.5/PM10 **(Top)** and the relative changes of different primary and secondary aerosol species **(Bottom)** within 2 weeks before and after a significant dust and fire event 2019 (crop residue burning).

Sources and Radiative Impact of Carbonaceous Aerosols over the Central Himalayas

The first simultaneous high-resolution delineation of primary organic carbon (POC) and secondary organic carbon (SOC) content was carried out for the Central Himalayas using four-year (2014–2017) online observations. POC exhibited significant unimodal diurnal variations with higher values during daytime (**Figure 30**) and POC (4.7–8 μg m^{-3}) showed dominance over SOC (2.4–3.9 μg m^{-3}). The role of crop residue burning in northern India and forest fires was shown to be dominant in spring while local heating purpose emissions dominated in winter. Further, it was showed that the contribution of fossil fuel combustion (eBCff) is 3.5 times greater than that of biomass burning (eBCbb). Monthly variations in mean diurnal amplitudes of eBCff and eBCbb revealed that the differences in their amplitudes (9–32%) is smallest during April–May, depicting the relative importance of biomass emissions at the diurnal scale during spring. The estimated daily radiative forcing showed that eBCff contributes more (16.4%) atmospheric forcing than eBCbb. Atmospheric forcing from both eBCff and eBCbb was higher (19.8 and 13.0 W m^{-2}, respectively) in the afternoon than morning. **[Srivastava, Priyanka, Naja, Manish** & Seshadri, T. R. (2023). *Aeros. Air Quali. Res., 23* (10), 220381 (20 pp)**]**.

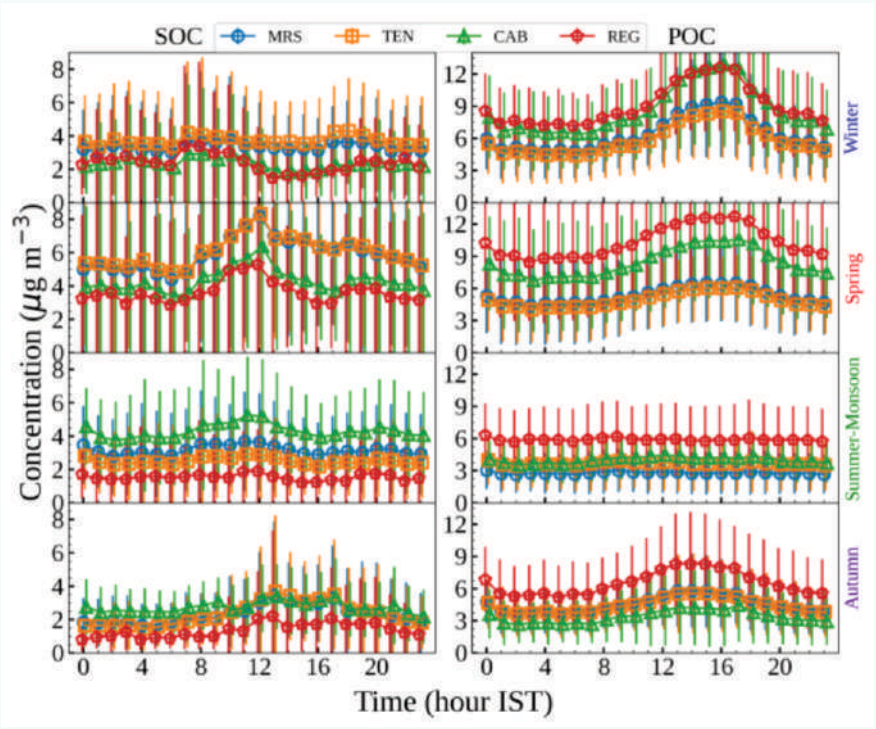


Figure 30. The diurnal variations in SOC and POC obtained using four methods (MRS, CAB, TEN, and REG) for different seasons during 2014–2017.

Utilising BC observations to estimate CO contributions from fossil fuel and biomass burning in the Central Himalayan region

This study utilised five years (2014-2018) of ground-based observations of eBC and multiple linear regression framework (MLR) to estimate CO and segregate its fossil fuel and biomass emission fractions at a high-altitude (1958 m) site in the Central Himalayas. The results showed that MERRA2 always underestimates the observed CO; MOPITT has a high monthly difference ranging from -32% to +57% while WRF-Chem simulations underestimate CO from February to June and overestimate in other months. In contrast, CO estimated from MLR replicates diurnal and monthly variations and estimates CO with an r2 > 0.8 for 2014-2017. The CO predicted during 2018 closely follows the observed variations, and its mixing ratios lie within ±17% of the observed CO (**Figure 31**). The results revealed a unimodal diurnal variation of CO, COff (ff: fossil fuel) and CObb (bb: biomass burning) governed by the boundary layer evolution and upslope winds (**Figure 32**). COff had a higher diurnal amplitude (39.1 to 67.8 ppb) than CObb (5.7 to 33.5 ppb). Overall, COff was the major contributor (27%) in CO after its background fraction (58%). CObb fraction reached a maximum (28%) during spring, a period of increased agricultural and forest fires in Northern India. In comparison, WRF-Chem tracer runs underestimated CObb (-38% to -98%)

while they overestimated the anthropogenic CO during monsoon. This study thus attempted to address the lack of continuous CO monitoring and the need to segregate its fossil fuel and biomass sources, specifically over the Central Himalayas, by employing a methodology that utilised the existing network of eBC observations. [Srivastava, Priyanka & **Naja, Manish** et al. (including Rajwar, M. C.). (2024). *Environ. Pollu., 341*, 122975**]**.

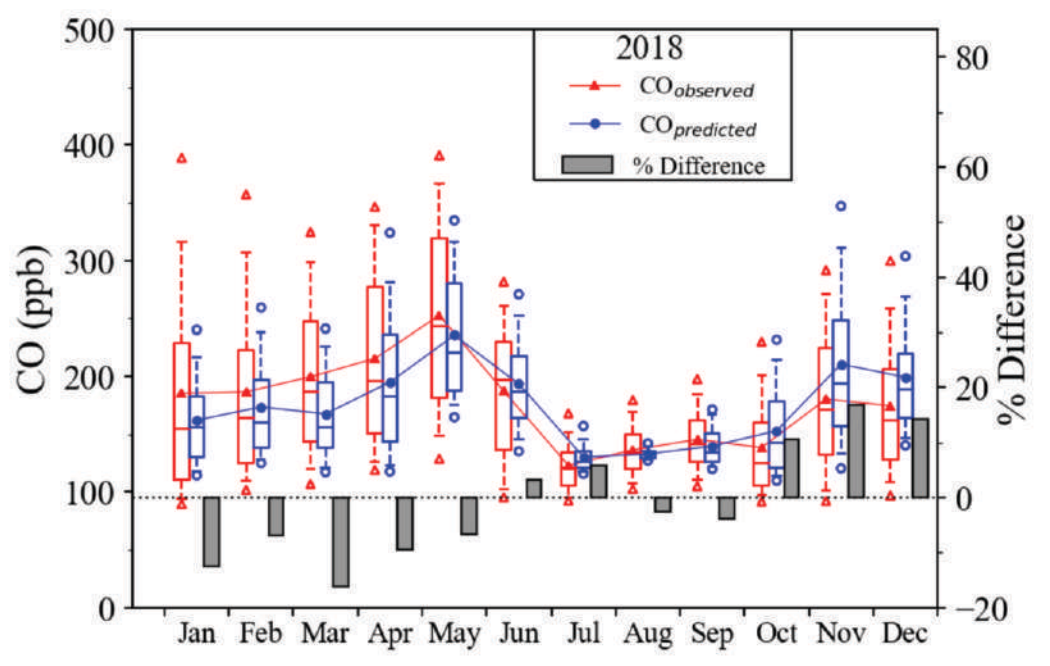


Figure 31. The monthly mean variation in observed CO and predicted CO for 2018. The percentage difference between observed and predicted CO for 2018 is also shown by grey bars.

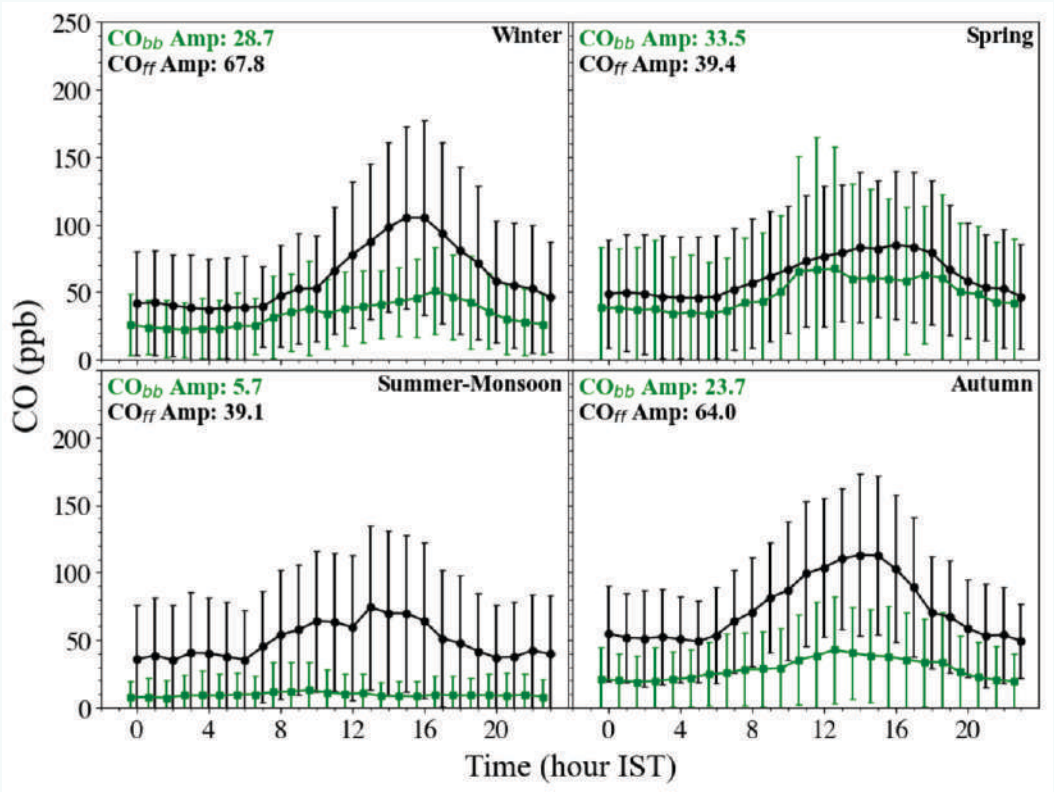


Figure 32. Diurnal variations of averaged fossil fuel (COff) and biomass burnt component (CObb) of CO in winter, spring, summer-monsoon and autumn during 2014-2017. The diurnal amplitudes are also mentioned.

Assembling a High Energy Pulse Lidar (HEPL) System: Preliminary Results from an Astronomical Site in the Central Himalayan Region

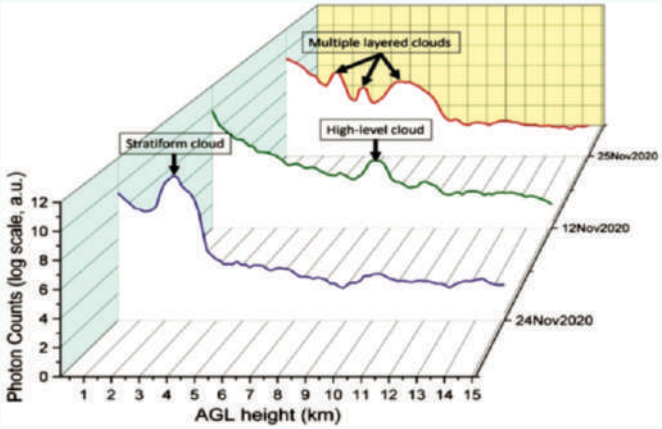


Figure 33. Vertical profile of photon counts from LIDAR for different cloud types including low-level layer cloud (stratiform) high-level layered cloud (Cirrus) and multi-layer clouds.

During the vertical profiling of the atmosphere on various occasions, HEPL detected the presence of low, middle, and high-level clouds, which were stationary or sometimes moving patches of clouds in nearly clear sky conditions. However, at the same time, the aerosol profile was observed up to about 3 km vertical resolution. This ensured the functionality and response of the system to various atmospheric conditions, which requires further measurements in different seasons over a year to yield better scientific output. By maintaining a manual logbook of the observations, three different cloudy profiles detected by the HEPL system are plotted in **Figure 33**, including a low-altitude stratiform cloud (24 November 2020), a high-level cirrus cloud layer (12 November 2020), and multiple layered clouds (25 November 2020). This also confirmed the reliability of the LIDAR observations in terms of detecting cloud layers. Longer observations along with the sky-imager observations are needed to support this finding and classify the cloud layers. Ground-based observations could be utilised to improve the satellite products. Overall, aerosols and cloud presence strongly affect astronomical observations conducted over this site, and these LIDAR observations can be utilized for both atmospheric profiling and astronomical seeing studies across the data void region of the central Himalaya. **[Singh, Narendra, Prakash, Chandra, Kumar, Ashish, Chauhan, Mayank, Singh, Jaydeep & Rawat, Vikas**. (2024). *Indian Jr. Pure & Applied Phys., 62*, 238-244**]**.

Impacts of different boundary layer parameterization schemes on simulation of meteorology over Himalaya

The effect of planetary boundary layer (PBL) parameterization schemes were evaluated on simulated meteorology using the WRF model over the central Himalayan region during clear-sky conditions. The

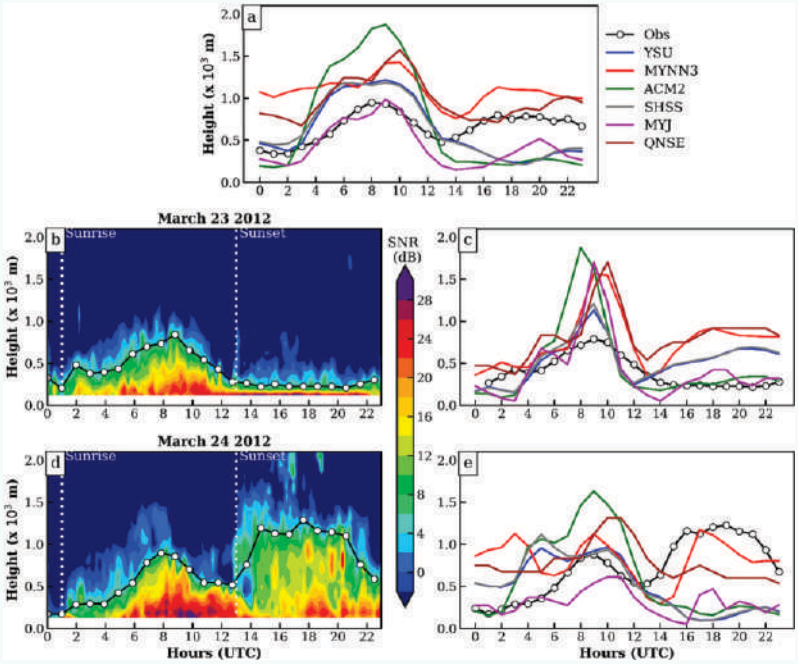


Figure 34. Diurnal variation of PBL height (PBLH) (a) simulated using different PBL schemes and RWP observations. The variation of SNR (signal-to-noise ratio) along with PBLH for (b) March 23, 2012, of low PBLH during the night and (d) March 24, 2012, of higher PBLH during the night. The simulated PBLHs are compared with the estimated PBLH in panels (c) and (e) for both days, correspondingly.

simulations were assessed against state-of-the-art measurements from the GVAX campaign. The observed mean value of the PBL height (PBLH) was 661 ± 350 m with strong diurnal variability. The comparison of the simulated boundary layer height by different PBL schemes with observations is shown in **Figure 34**. The PBLH simulated by non-local schemes YSU and SHSS was found to be closer to the RWP observation with lower MBE (≤ −20 m) and RMSE (~ 550 m) with weak correlation (~ 0.20). The MYJ underpredicted the PBLH by −221m but showed better correlation (0.28) as compared to other PBL schemes. The MYNN3 and QNSE strongly overestimated the PBLH and show higher MBE (446 m and 331) and RMSE (737 and 691 m). In contrast, these schemes showed the best performance in terms of simulating the PBLH over the homogenous IGP region and other tropical zones. The comparison in **Figure 34a** showed that the model performance is different for the daytime CBL and nocturnal SBL. **[Singh, Jaydeep, Singh, Narendra** et al. (2024). *Atmos. Res., 298*: 107154 (15pp)**]**.

List of Publications

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Astronomy & Astrophysics

1. **Joshi, Jagdish C.,** Tanaka, Shuta J., Miranda, L. S. & Razzaque, Soebur. (2023). Study of maximum electron energy of sub-PeV pulsar wind nebulae by multiwavelength modelling. *Mon. Not. Roy. Astron. Soc., 520*, 5858–5869.

2. **Jalan, Priyanka, Rakshit, Suvendu**, Woo, Jong- Jak, Kotilainen, Jari, & Stalin, C. S. (2023). An empirical relation to estimate host galaxy stellar light from AGN spectra. *Mon. Not. Roy. Astron. Soc. Letters, 521*, L11-L16.

3. **Aryan, Amar, Pandey, S. B., Gupta, Rahul & Ror, Amit Kumar**. (2023). Evolution of rotating 25 M□ Population III star: physical properties and resulting supernovae. *Mon. Not. Roy. Astron. Soc. Letters, 521*, L17-L23.

4. Sarmah, P., Chakraborty, S. & **Joshi, Jagdish C.** (2023). Probing LHAASO galactic PeVatrons through gamma-ray and neutrino correspondence. *Mon. Not. Roy. Astron. Soc., 521*, 1144–1151.

5. **Panchal, Alaxender** & **Joshi, Y. C.** et al. (2023). Optical characterization and radial velocity monitoring with Belgian and Indian telescopes (ORBIT): the eclipsing binaries EPIC 211982753 and EPIC 211915147. *Mon. Not. Roy. Astron. Soc., 521*, 677–689.

6. **Rawat, Nikita** & **Pandey, J. C.** et al. (including **Rao, Srinivas M.**). (2023). Confirmation of two magnetic cataclysmic variables as polars: 1RXS J174320.1-042953 and YY Sex. *Mon. Not. Roy. Astron. Soc., 521*, 2729-2744.

7. **Joshi, Raj Kishor** & **Chattopadhyay, Indranil** (2023). The Morphology and Dynamics of Relativistic Jets with Relativistic Equation of State. *Astrophy. Jr., 948:* 13(10pp).

8. **Kaithakkal, Anjali J.**, Borrero, J. M., Yabar, A. Pastor & Rodríguez, J de la Cruz. (2023). A reconnection-driven magnetic flux cancellation and a quiet Sun Ellerman bomb. *Mon. Not. Roy. Astron. Soc., 521*, 3882-3897.

9. Valtonen, Mauri J. et al. (including **Gupta, A. C.**). (2023). Refining the OJ 287 2022 impact flare arrival epoch. *Mon. Not. Roy. Astron. Soc., 521*, 6143-6155.

10. Joshi, Arti et al. (including **Rawat, Nikita, Pandey, J. C.** & **Rao, Srinivas M.**). (2023). Unravelling optical and X-ray properties of the disc-dominated intermediate polar IGR J15094-6649. *Mon. Not. Roy. Astron. Sco., 521,* 6156-6169.

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15. Kaur, Harmeen & **Sharma, Saurabh** et al. (including **Verma, Aayushi, Panwar, Neelam** & **Ghosh, Arpan**). (2023). Structural analysis of open cluster Bochum 2. *Jr. Astrophys. Astron., 44*: 66(11pp).

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27. **Verma, Aayushi, Sharma, Saurabh** et al. (including **Ghosh, Arpan**). (2023). Kronberger 55: A candidate for end-dominated collapse scenario. *Jr. Astrophys. Astr., 44*: 52(13pp).

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Atmospheric Sciences

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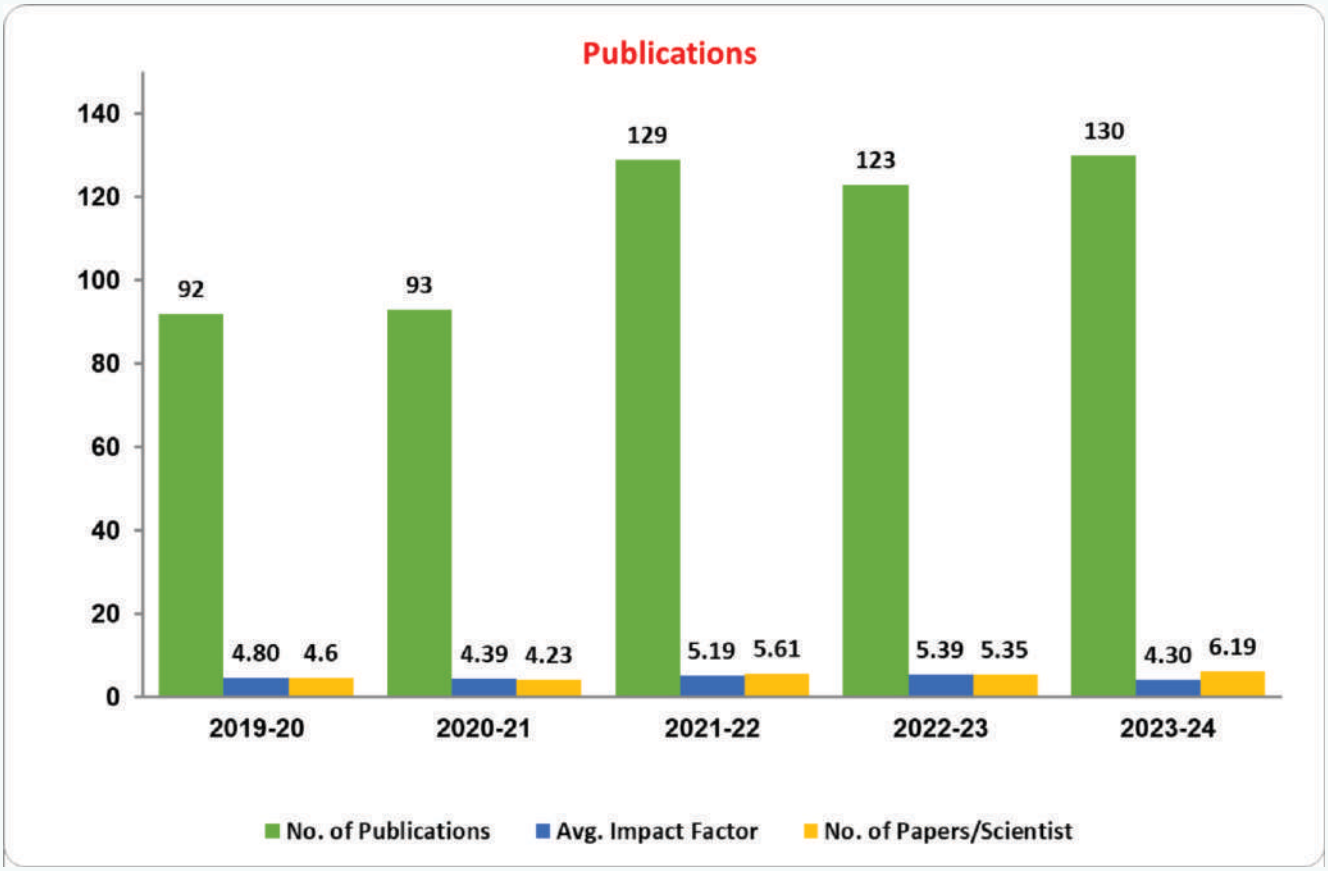

Figure 35. Publications in refereed journals from ARIES during the last five years.

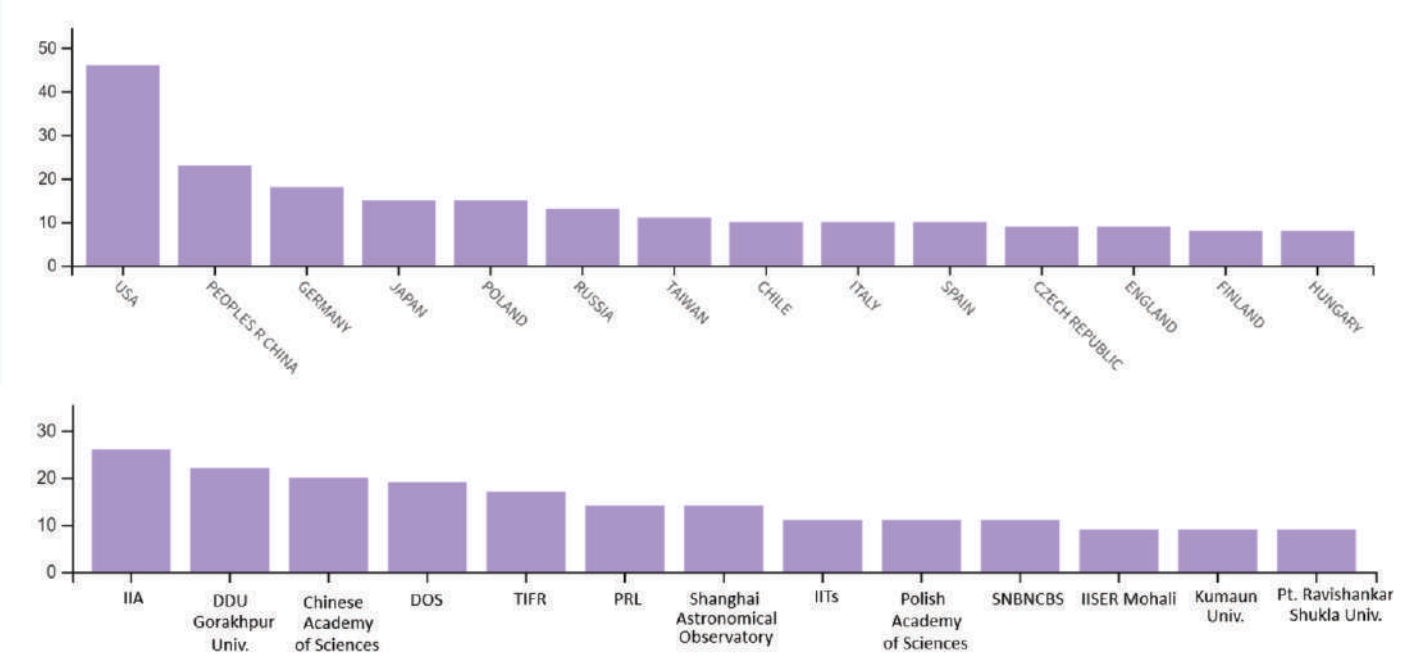

Figure 36. ARIES's top collaborating countries **(Top)** and institutes **(Bottom)** in the publications during 2023-2024. *(Source: Web of Science)*

International and National Research Projects

Name of Project: Constraining the Nature of Multi-messenger Transients with Coordinated Multi-wavelength Observations (CoNMuTraMO)
PI (ARIES): Kuntal Misra
Funding Agency: DST-BRICS
Project Code: DST/ICD/BRICS/Call-5/CoNMuTraMO/2023 (G)

Name of Project: Belgo-Indian Network for Astronomy and Astrophysics (BINA)-2
P I (ARIES): Santosh Joshi
P I of the Collaborating Institute: Peter De Cat, ROB, Belgium
Funding Agency: DST, Govt. of India
Project Code: DST/INT/BELG/P-09/2017

Name of Project: International Liquid Mirror Telescope.
PI (ARIES): Kuntal Misra
PI of the collaborating institute: Jean Surdej, Liege University, Belgium
Funding Agency: ARIES, Belgium and Canada
Project Code: CSNOF-09

Name of Project: Probing fundamental characteristics of extreme astrophysical phenomenon.
PI (ARIES): Shashi B. Pandey
PI of the collaborating institute: IUCAA Pune, IIT Bombay, IKI Moscow Russia, SAAO and other institutes of South Africa
Funding Agency: DST, Govt. of India and BRICS consortium
Project Code: DST/IMRCD/BRICS/PILOTCALL1/PROFCHEAP/2017G

Name of project: An interdisciplinary study toward clean air, public health and sustainable agriculture: the case of crop residue burning in North India.
PI (ARIES): Narendra Singh
Funding Agency: RIHN (Research Institute for Humanity and Nature), Japan

Name of project: Indo-Uzbek Proposal: Search for variable stars in open star cluster.
PI (ARIES): Ramakant S. Yadav
PI of the collaborating institute: Alisher Hojaev, Ulugh Beg Astronomical Institute, Uzbekistan Academy of Sciences, Tashkent.
Funding Agency: DST, Govt. of India
Project code: INT/Uzbek/P-19

Name of Project: Search and Follow-up Studies of Time-domain Astronomical Sources using Sky Surveys, BRICS Telescopes, and Artificial Intelligence
PI (ARIES): Santosh Joshi
PI of the Collaborating Institute: Oleg Malkov INASAN, Moscow, Kefeng Tan, NAOC, China
Funding Agency: DST, Govt. of India
Project Code: DST/ICD/BRICS/Call-5/SAPTARISI/2023(G)

Name of Project: Probing wave energy transport in the solar atmosphere (PROTSAhan)
PI (ARIES): Vaibhav Pant
Funding Agency: SERB (DST), Govt. of India
Project Code: SRG/2022/001687

Name of Project: Probing Influence of radiative feedback in massive star-forming complexes
PI (ARIES): Neelam Panwar
Funding Agency: SERB (DST), Govt. of India
Project Code: CRG/2021/005876

Name of Project: Study of Stability and Outburst in Luminous Blue Variables (LBV)
PI of the Collaborating Institute: Abhay Pratap Yadav, NIT, Rourkela
Co-PI (ARIES): Santosh Joshi and Yogesh C. Joshi
Funding Agency: SERB (DST), Govt. of India
Project Code: CRG/2021/007772-G

Name of Project: Supermassive black holes in AGN through spectro-polarimetry at 3.6m DOT using in-country developed spectrograph and camera
P. I. (ARIES): Suvendu Rakshit
Funding Agency: SERB (DST), Govt. of India
Project Code: SRG/2021/001334

Name of Project: Wave dissipation in the magnetised solar atmosphere: Implications on heating and seismology
P. I. (ARIES): S. Krishna Prasad
Funding Agency: SERB (DST), Govt. of India
Project Code: SRG/2023/002623

Name of project: Observations of trace gases at a high altitude site in the Central Himalayas.
PI (ARIES): Manish Naja
Funding Agency: Indian Space Research Organization (ISRO), India.

Name of project: Study of the aerosol characteristics over central Himalayas.
PI (ARIES): Manish Naja
Co-PI (ARIES): Umesh C. Dumka
Funding Agency: Indian Space Research Organization (ISRO), India.

Name of project: Atmospheric Boundary Layer Network & Characterization: Network of Observatories for Boundary Layer Experiments (ABLN&C: NOBLE).
PI (ARIES): Narendra Singh
Funding Agency: ISRO, VSSC Trivandrum

Highlights from Engineering Division

The engineering division caters to the design, development, maintenance and upgradation requirements of ARIES, with primary focus on astronomical telescopes and back-end instruments. It also supports maintenance of the ARIES infrastructure. The division is a multidisciplinary group with four sub-divisions: mechanical, optics, computer, and electronics & electrical. The laboratory resources are shared dynamically for the projects/tasks at hand. The overall site activities, preventive maintenance of the observing facilities, project management and system engineering work are managed smoothly by the division.

Mechanical Engineering Section

The mechanical section has a well-equipped workshop with various machines, including a vertical machining centre CNC, conventional machines such as lathes, milling machines, radial drills, surface grinders, mechanical power hacksaws, tool grinders, air compressors, single-phase and three-phase machines, TIG welding machines, a portable CMM machine etc. The section engineers are proficient in Pro E, Unigraphics, AutoCAD, Ansys, Mastercam software, etc., for design simulation and computer-aided manufacturing of critical mechanical systems.

1. Design, Fabrication, Installation and Testing of Cable Anti-Twister for 3.6 m DOT

For improvements in the operation of the 3.6m DOT, a cable anti-twisting mechanism was developed. In this, the cable is routed by providing an extra loop at the pier exit hole towards the bottom and allows the cable to wrap and unwrap during the telescope rotation as shown in **Figure 37**. Required components were fabricated, assembled and installed at the site. A dry run was performed to test the strain on the cables during the telescope rotation. After successful testing, the arrangement is presently being used for the Helium lines of the TANSPEC. The same arrangement will also be used for the optical fiber and communication cables for the upcoming fiber fed instrument HRS.

Figure 37. Schematic layout for cable anti-twister.

2. Assembly & installation of Side Port Imager (SPIM)

The section carried out the mechanical design, assembly and installation of the Side Port Imager (SPIM) instrument for 3.6m DOT **(Figure 38)**. The instrument has the option of two detectors on a rotational stage. Different vital tasks, e.g. fine-tuning the rotational speed, filter wheel repeatability, instrument integration with the telescope and instrument balancing, were performed successfully by the section.

Figure 38. SPIM instrument integrated with 3.6m DOT.

3. Dipole Antenna Fabrication for ST Radar

The existing balloon box at the ASTRAD is deteriorating

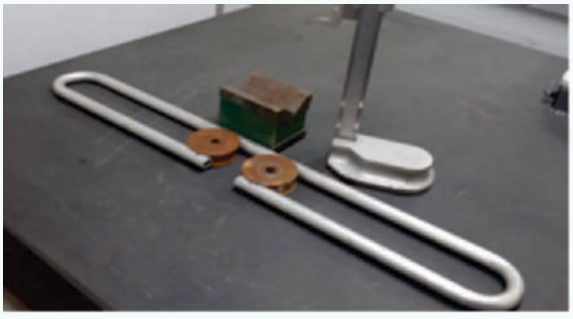

Figure 39. Dipole antenna for ST radar.

due to harsh weather exposure. The section modified the dipole antenna box design to prevent deterioration and manufactured the tools required for bending as per the accuracy of the antenna design. The whole system was fabricated and assembled within the section **(Figure 39)**.

Optics Section

The optics section contains two sub-divisions – design & development and facility maintenance. It is involved in the upkeep of all optical aspects of the observing facilities, e.g. aluminium coating of telescope mirrors, maintaining the scientific quality of imagers, evacuating and cooling the detectors, testing and correcting/replacing the different components of the instruments etc.

1. Design & Development

Preliminary Optical design of a probe viewer and calibration system has been carried out for TA-MOONS (TIFR-ARIES Multi-Object Optical Near Infrared Spectrograph) instrument to guide the stars on the probes and provide the light from the calibration lamps. A removable 50/50 beam splitter is inserted into the path for target acquisition. The beam splitter splits the light beam into the instrument and to a plane mirror at the focal plane on the left side. The plane mirror mounted permanently on the cryostat lid is the reference for focus. The reflected beam is imaged onto a large area 4k × 4k CMOS array. The entire 12 arc-min FOV is imaged onto this single array by the F#1.9 camera. The same optics will be used for illuminating the spectrograph with calibration light. A deployable fold mirror will be inserted before the CMOS detector to redirect the light from an integrating sphere with a diffuser window. Different wavelength calibration lamps and continuum lamps will be mounted at the input port of the integrating sphere.

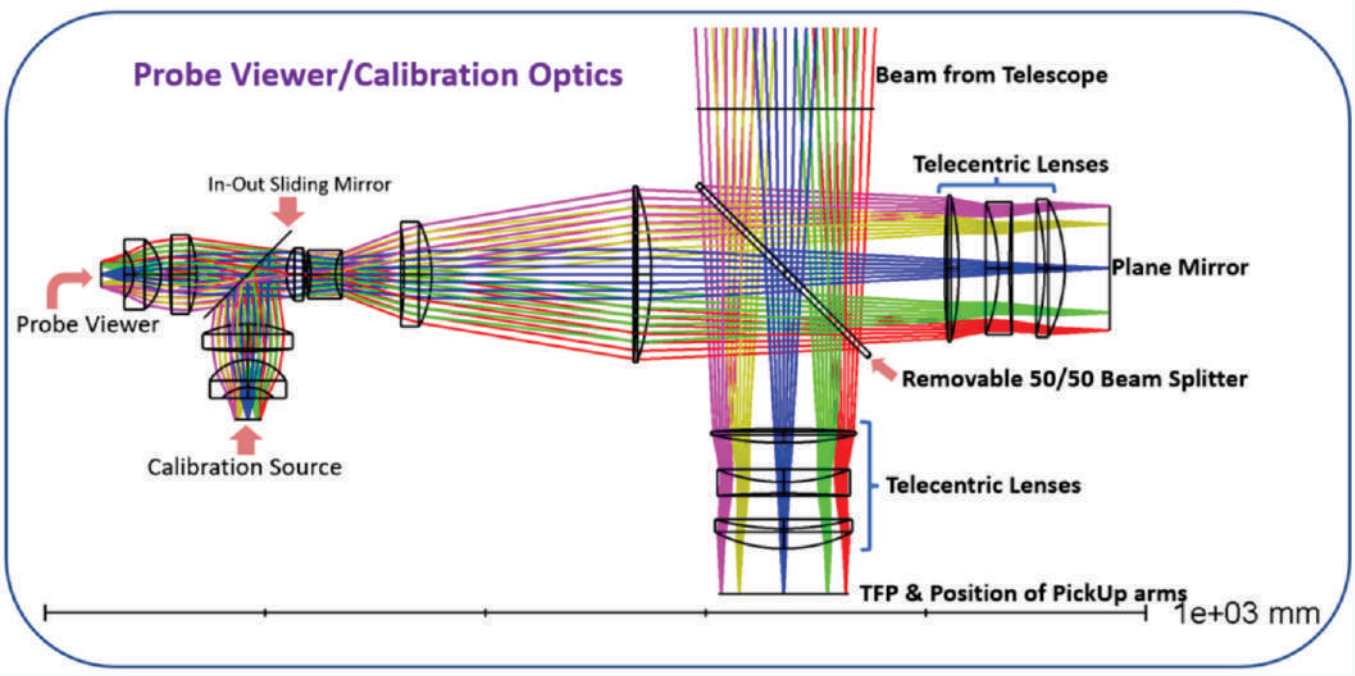

Figure 40. Optical layout of TA-MOONS, telecentric system with probe viewer and calibration optics.

Preliminary Optical design of complete optical channel spectrograph has been carried out for TA-MOONS **(Figure 40, 41)**. Several versions of the optical design were carried out using different gratings and cross dispersers before finalising the white pupil design. OAP-Mirror collimates light from the slit, which is dispersed by the grating element. The dispersed light is again focused and re-collimated by the same OAP mirror to form the white pupil, where the prisms for cross dispersion of the various orders are kept. Both arms use orders 3,4,5,6 and 7 of two separate gratings.

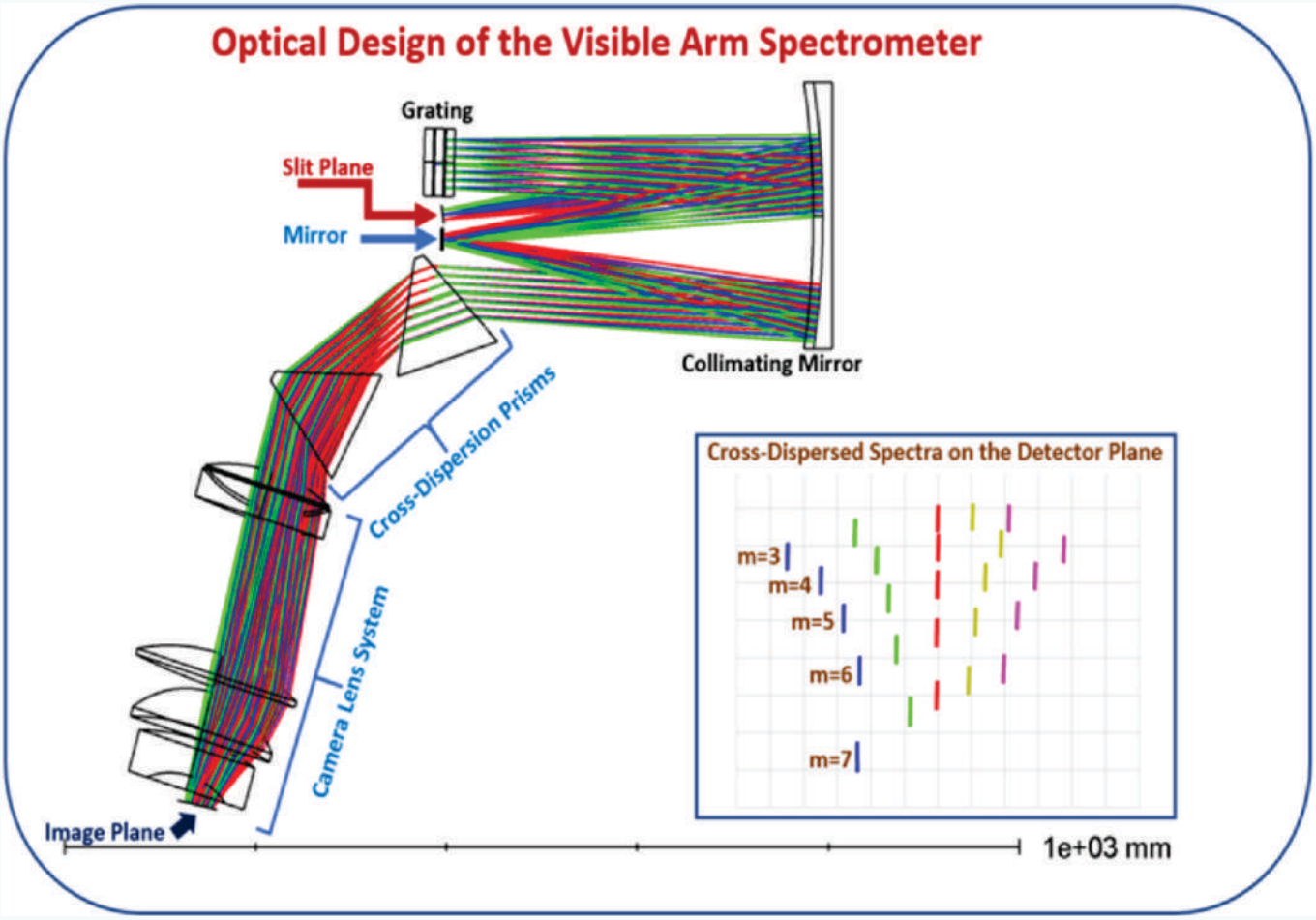

Figure 41. Optical layout of optical channel spectrograph of TA-MOONS.

The non-deviating compound prism, designed for slitless low-resolution spectroscopy for FOSC, has been integrated into the grism wheel, and slitless images were taken on the sky **(Figure 42)**. Target of the design is to maintain the required spectral resolving power of R~200-300 or linear dispersion of ~2nm/pixel at un-deviated wavelengths 400 - 700nm.

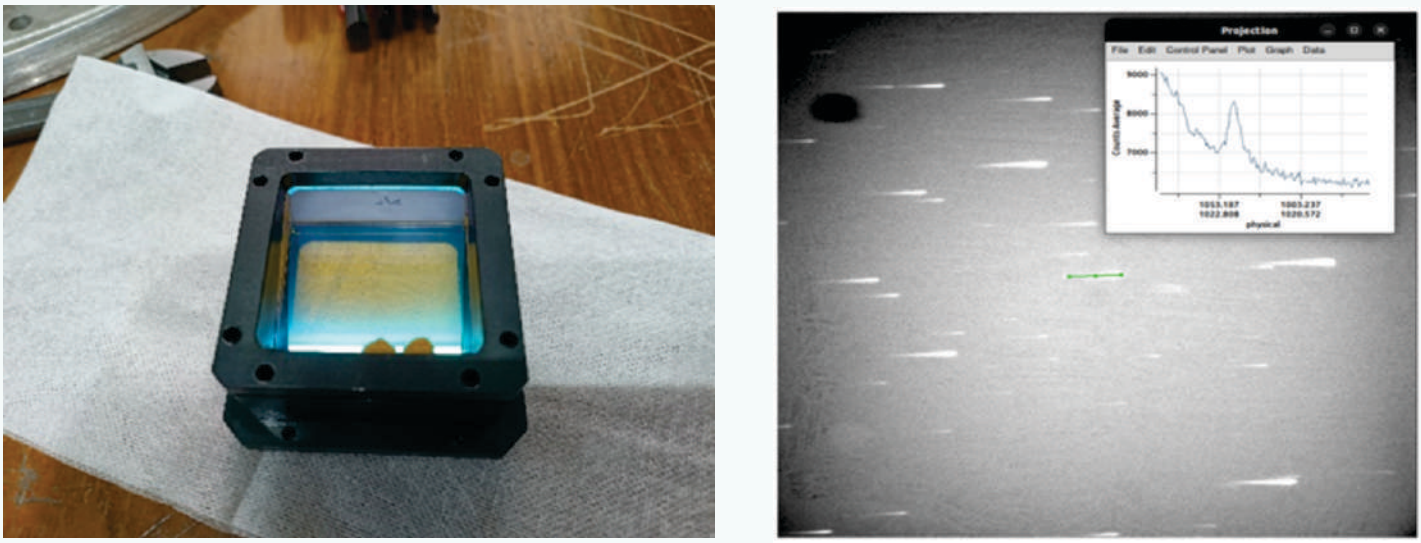

Figure 42. Compound prism with mount **(Left)**, Slitless low-resolution spectra **(Right)**.

Complete assembly integration of Side Port IMager (SPIM) was carried out, which included assembly integration of CCD, controller, chiller, and filters **(Figure 43)**. The alignment of the CCD was verified after necessary modifications to the mechanical structure to keep the CCD at its exact location. Complete routing of optical fiber cables, controller power cables, and chiller lines was done. On sky image quality was verified. Some stray light from ARISS was identified initially. Some baffles were designed and introduced to resolve the issue.

Figure 43. SPIM mounted with filters, CCD on 3.6m DOT side port.

Procurement of actual sizes (34 mm x 64 mm) of Wollaston prisms for spectro-polarimetry is completed and bought

Figure 44. Wollaston prism with its mount.

from an Indian company **(Figure 44)**. This prism will be mounted on the FOSC, and subsequently tested.

2. Observing Facilities Maintenance

The axial define #1 mirror pad got unglued from the 3.6m DOT primary mirror surface. Because of that, the performance of the 3.6m DOT was restricted. The mirror pad re-gluing activity was carried out successfully, and the telescope's performance was restored. This time, a new approach was followed to reglue the pad, enabling us to glue it without unmounting the primary mirror from its cell. This new approach has saved valuable observing time.

Back-end instruments, e.g. ADFOSC, TANSPEC, TIRCAM and 4k Imager, were made ready for observations as per the observation cycle; it includes activities like the Dewar evacuation & cooling, mounting/unmounting of UBVRI, SDSS filters, grisms, prisms and helium and power lines

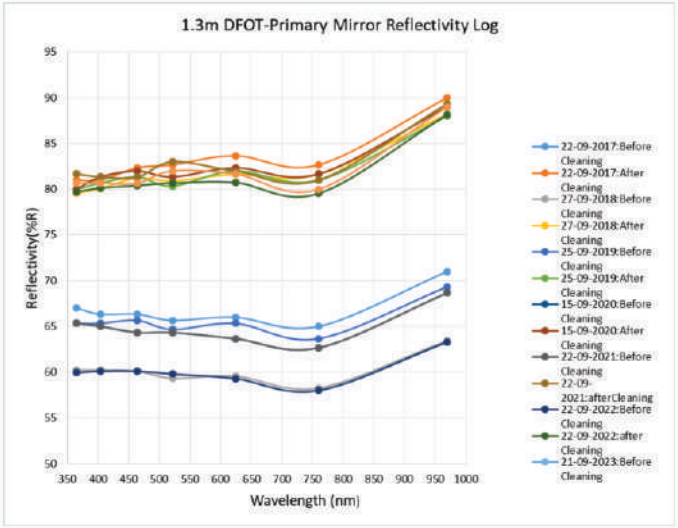

Figure 45. 1.3m DFOT Primary mirror reflectivity measurements of before and after cleaning.

routing etc. The cleaning of optical components and respective measurements, e.g. transmission/reflection etc., were carried out. The detector used in ILMT was evacuated, and PT-30 gas was refilled in the cryo compressor.

Scheduled in-situ CO_2 / distilled water cleaning of primary mirrors of DOT and DFOT was carried out, and reflectivity logs were maintained **(Figure 45)**.

As a part of the upgradation, procurement of 30kVA UPS with built-in isolation transformer and 7.5kW drive in an enclosure (including replacement of existing panel with new panel and associated earthing, cabling works and dismantling of existing panel at vacuum coating plant) was completed **(Figure 46)**. Installation and commissioning were completed. Rotary pump servicing was carried out after procuring new spares. Indigenous water recirculation/ chiller for the 40-inch coating plant was designed, manufactured, and assembled to avoid water wastage, as there was a lot of water wasted during the plant operation.

Figure 46. 30KVA UPS and control panel installed at 40-inch coating plant.

A narrowband solar filter with a temperature controller oven was procured to support the total solar eclipse expedition. Transmission, spectral band measurement and shift wrt temperature were measured in the laboratory **(Figure 47)**.

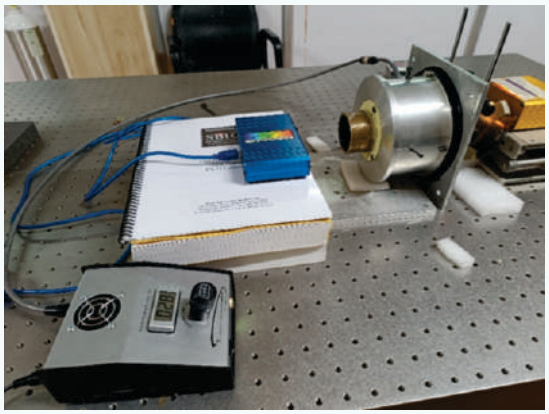

Figure 47. Testing of narrow band solar filter.

Electronics/Electrical Section

The electronics laboratories primarily support instrumentation for observing facilities. The infrastructure includes embedded systems laboratory, CCD laboratory, software development laboratory and electronics laboratory for telescopes and instruments. These labs enable the integrated design and development of cutting-edge technology for telescope systems and instruments. The labs house essential spares for telescopes, including drives, encoders, and other critical components which are vital for ensuring seamless operation of the facilities. The electrical section is responsible for the installation and maintenance of electrical infrastructure, including central UPS systems, SCADA-based electrical substations, and power distribution for both office and residential premises.

A humidity and temperature-controlled room has been set up as a training room for hands-on learning of B.Tech and M.Tech students **(Figure 48)**. The room ensures that the sensitive electronics and other equipment are protected from the environmental factors.

Figure 48. A humidity and temperature-controlled training room.

The electronics lab has been extended to accommodate a new UPS room **(Figure 49)**. The successful installation, testing, and commissioning of a 20 kVA UPS along with battery banks have been completed, ensuring uninterrupted power supply for critical laboratory operations. This infrastructure upgrade ensures operational continuity and enhances the lab's ability to maintain high precision in its electrical and electronics projects.

Refurbishment work is actively underway at the Schmidt telescope facilities in collaboration with ISRO. The primary goal of this project is to make the facility fully operational and enhance its capabilities for advanced astronomical research. The refurbishment project is on track with scheduled milestones, aiming for completion within the

planned timeframe to resume telescope operations as soon as possible.

A CMOS autoguider camera has been successfully mounted on the 1.3m DFOT. The camera has been tested and successfully integrated with the telescope's existing systems. The testing involved calibration procedures, alignment checks, and real-time guiding trials.

A filter wheel controller was developed for SPIM. A graphical user interface (GUI) has been developed for seamless interaction with the filter wheel controller. The GUI allows users to easily select filters, monitor system status, and configure settings from a user-friendly interface.

A VRV (Variable Refrigerant Volume) air conditioning system has been planned for the ILMT compressor room to maintain an optimal and precise temperature within the room. It is crucial for a stable and reliable operation of the compressor by preventing overheating.

An advanced simulation instrument, Speedgoat Real-Time Target Machine, has been procured and training for its use has been conducted. It has been integrated into the laboratory enhancing the ability to test and validate complex control systems in a virtual environment. This allows more robust modelling of the telescope behaviour in various scenarios. Comprehensive training sessions on DSPACE and MATLAB software have been successfully conducted to enhance the team's expertise.

Figure 49. The 20kVA UPS system installed in the electronics lab.

Computer Section

The Computer Section of ARIES is committed to providing advanced, efficient and effective computational network infrastructural facilities and services for smooth operation of the major facilities of the institute. With a limited strength of Engineers, Sr. Engg. Asst., and contractual/Project staff, the section has handled and executed several works during 2023-24. An overview of the extent to which the section workforce was involved is shown in ***Figure 50****.*

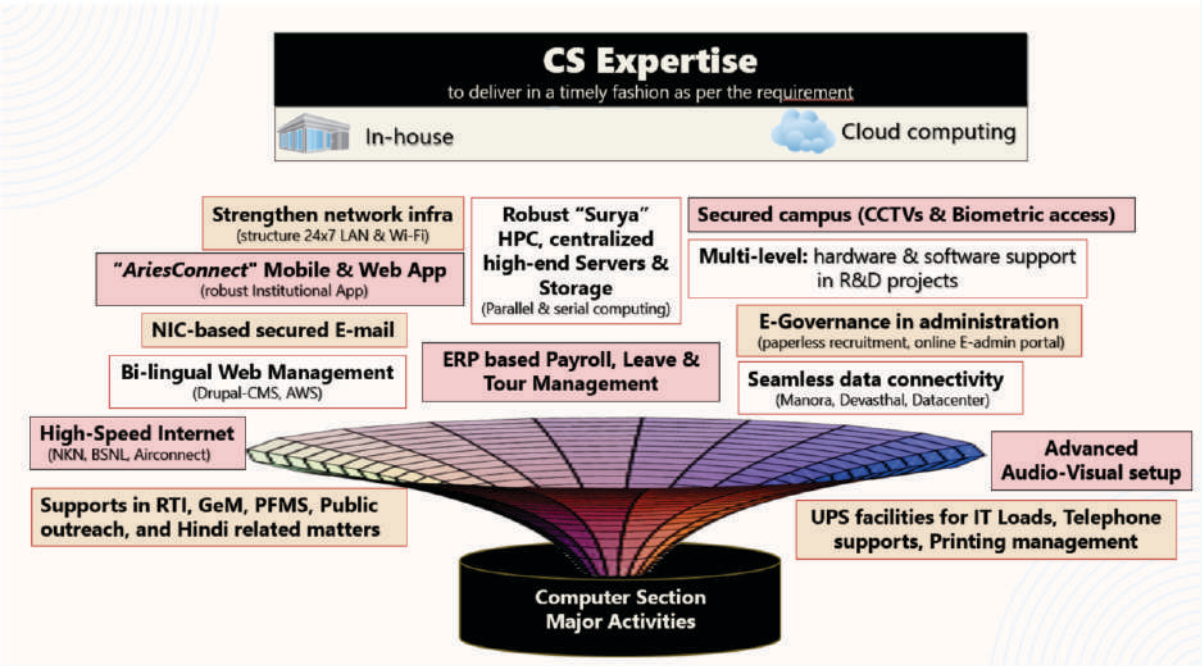

Figure 50. An overview of the involvement by Computer Section.

1. Renovation of Intranet Web-Portal

The section worked towards renovation & modernisation of the older intranet web portal through creation of different webforms, visualisation, facility logs, etc. **(Figure 51)**

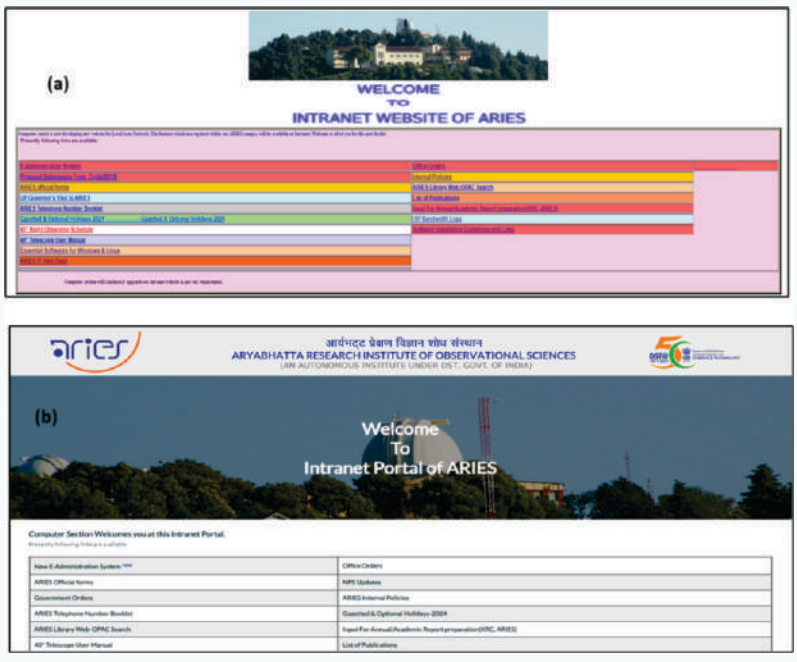

Figure 51. Older view (a), new view of the ARIES Intranet portal (b).

2. Development of an in-house 'AriesConnect' mobile and web App

The section designed and developed a powerful institutional app 'AriesConnect' offering several salient features e.g. 24x7 cloud-based accessibility from anywhere, Android and iOS support, viewing & downloading office orders, government orders, official forms, monthly pay-slips, internal policies, NPS updates, telephone directory, etc. The app also facilitates the retired employees to view their monthly pay-slips and allows them to upload their Life Certificates **(Figure 52)**.

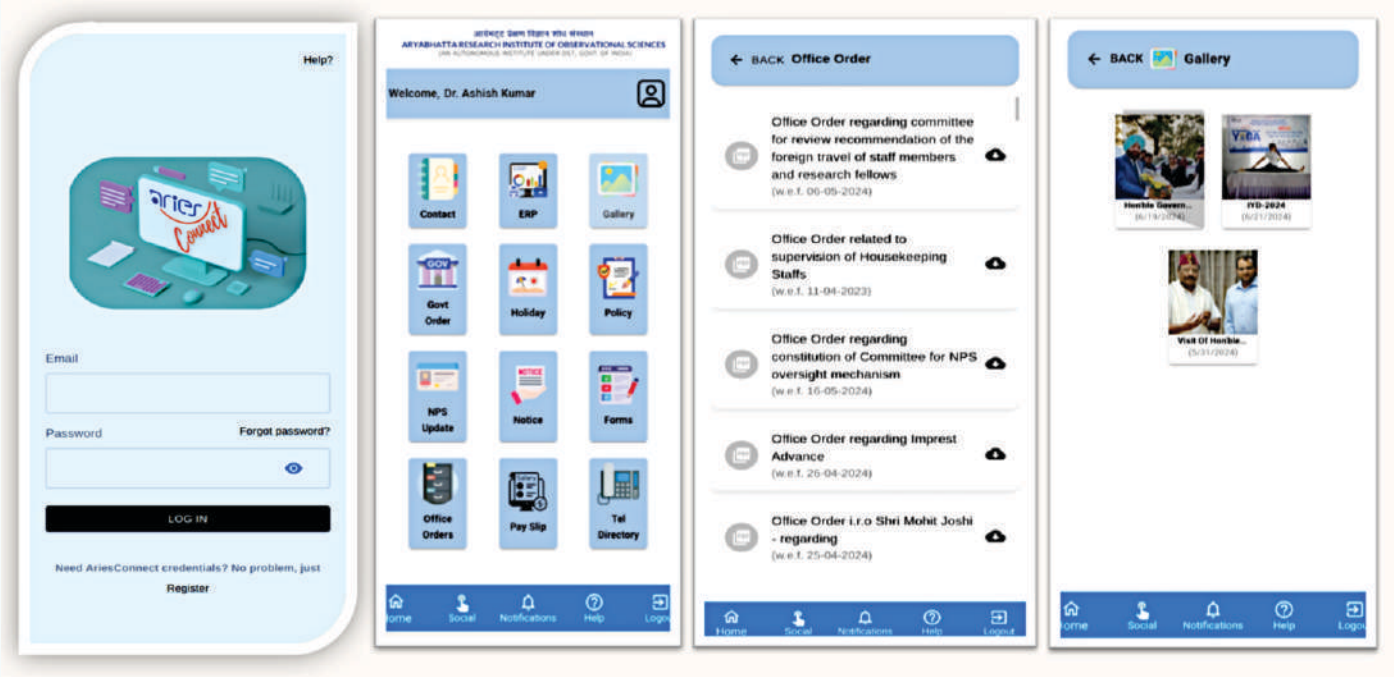

Figure 52. Institutional "AriesConnect" App.

To manage the content of this 'AriesConnect' app, the section also developed an ARIES Admin App Management (AAAM) Portal that allows managing user creation, handling the data on the App, viz. event images, office orders, different logs, etc. **(Figure 53)**

Figure 53. ARIES Admin App Management (AAAM) Portal.

3. Enterprise Resource Planning (ERP) Implementation

Under the ERP project, we moved a step ahead, and now we are handling 100% of payroll processing, leave management, and tour requests through the ERP automated portal **(Figure 54)**.

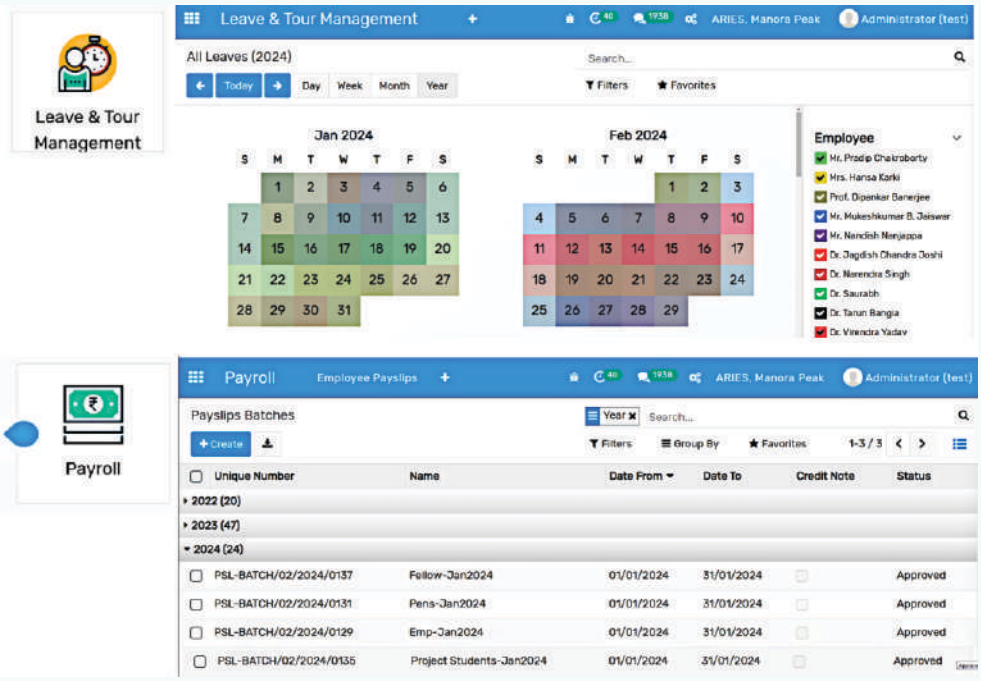

Figure 54. Leave & Tour, and Payroll management through ARIES ERP Portal.

4. *"Surya"* HPC & GPU interfaces

The section supports and maintains the centralised large-scale computing systems established to handle complex scientific and engineering computational loads. Users' accounts in the high-end "Surya" HPC facility and GPU workstation have been increased significantly. More than 07 peer-reviewed publications utilising the HPC facility for computation have been reported.

As a part of infrastructure development & maintenance activities, the section maintains the 2×20 kVA Modular UPS system and 2×5 Tr Precision Air conditioners (PAC) units installed for running the Surya HPC facility.

5. Connectivity Improvements

In the past, users had reported Wi-Fi disruption while moving from one building to another within the institute premises. The section introduced the "ONE INSTITUTE ONE WIFI" programme to resolve this situation and eliminate the pesky dead zones. This programme has one SSID, i.e. "ARIES-WIFI", and one password throughout ARIES (both Manora Peak and Devasthal campuses), providing seamless roaming.

6. Cloud Infrastructure

The section covers all the maintenance and upgrade activities of the deployed web applications on the AWS cloud infrastructure for smooth operation. Virtual servers allowed robust and better control over ARIES and *Aditya-L1* Support Cell websites, including data storage and sharing portals created on the cloud environment.

7. Paperless Administration

In addition to implementing paperless recruitment portals through an online application submission system for any job positions, the section has also developed management portals for managing the Hostels and Guest houses.

8. IP-Based CCTVs for Security

93 IP-based night-vision and outdoor CCTVs (bullet and dome) have been installed, out of which 60 cameras are at Manora peak and the remaining 33 are at the Devasthal location, with a total 56 TB storage capacity.

Reports from Observing Facilities

3.6 m Devasthal Optical Telescope (DOT)

ARIES operates India's largest 3.6 meter Devasthal Optical Telescope (DOT) at optical and near-infrared wavelengths as a National Facility and hosts a suite of complex instruments, a mirror coating plant, and a control room. The observing time on DOT is shared between India (93%) and Belgium (7%). On average, the night sky was fully clear for about fifty-five per cent of the time during April 2023 - March 2024, excluding the monsoon period.

The four core teams for the overall functioning and management of DOT are (I) DOT-team executing the day-to-day operation, maintenance and upgradation activities; (ii) Instrument-team accountable for the overall management of existing instruments (IMAGER, TIRCAM2, TANSPEC and ADFOSC) and development of upcoming instruments; (iii) DOT Time allotment Committee (DTAC) responsible for observing time allocation based on scientific merit of the proposal; (iv) DOT Operation, Maintenance and upgradation Committee (DOMU) to review the operation, maintenance and upgradation of both telescope and back-end instruments and advise ARIES on matters of concern.

The scientific activities performed are summarised below.

1. Observing period from April to May 2023

On the main axial port, the IMAGER instrument was mounted from Mar 27 to Apr 2, whereas the TANSPEC instrument was mounted from Apr 3 to May 31. The TIRCAM2 instrument was mounted on the side port1. All the DTAC-approved proposals were executed on the telescope, including proposals from Belgian astronomers. No major technical issue was encountered with the telescope, and the technical downtime was less than five percent. Due to pre-monsoon disturbance episodes, the night weather conditions were not favourable. Only 50 % nights were fully clear during the period, and the rest were either partly clear or cloudy. A summary pie-chart is given in **Figure 55.**

2. Observing cycle DOT-2023-C2 (October to January)

The science observing proposals on DOT were invited online via DOPSES - an online proposal submission and evaluation system hosted on the ARIES web server.

Call for proposals: By the middle of July, a call for proposals for 2023-C2 on 3.6m DOT was opened to the astronomical community of India, with a proposal submission deadline of 1st August 2023. Three instruments (TANSPEC, IMAGER, ADFOSC) were offered on the main-port and one on side-port1 viz TIRCAM2. The DOT Team made detailed computations of available time for science users. The time required for instrument change and telescope maintenance was appropriately reserved.

Scheduling: A total of 66 proposals were submitted online at DOPSES by astronomers from India and Belgium. The telescope time demanded by users was around two times more than available. The DTAC met from 14-15 September 2023 to review the proposals and recommend time allocation to respective proposers, and subsequently, a detailed schedule was prepared by the DOT-team in consultation with the Instrument-team members. Appropriate time is structured for ICT, DDT, TMT, and IVT. The 10% DDT time was allocated as a quarter for every alternate night. Figure 1 depicts the various statistics during 2023-C2.

Night observations: The observations were made in visitor mode during this cycle. The TIRCAM2 Instrument was mounted on side-port1 of the telescope and made available to users for the entire cycle. On the main axial port, the ADFOSC was mounted from Oct 1 to Nov 15 / 45 nights, IMAGER from Nov 16 to Nov 27 / 12 nights and TANSPEC from Nov 28 to Jan 31 / 65 nights. Overall, the 2023-C2 observations were performed successfully with a technical downtime of less than five percent.

3. Observing cycle DOT-2024-C1 (February to May)

Call for proposals: The announcement for proposals for cycle 2024-C1 was made on 1st November 2023 with a deadline of 1st December. Rigorous discussions were held to take a call on the sequence of instruments so that proposers could decide on the availability of targets in the sky well in advance. A tentative sequence of TANSPEC, ADFOSC, and IMAGER for main-port instruments was communicated to the proposers of this cycle. A summary pie-chart is given in **Figure 56.**

Scheduling: 43 proposals were submitted for Cycle 2023-C1 with an over-subscription factor of 2 for science proposals. The DTAC met during 17-18 January 2024 to review the proposals and recommend time allocation to

respective proposers and subsequently, a detailed schedule was prepared by the DOT team in consultation with the instrument team members. Figure 2 depicts the various statistics during 2024-C1.

Night observations: Operations during 2024-C1 were continued successfully. The TIRCAM2 Instrument was mounted on side-port1 with the telescope and made available to users for the entire cycle. On the main port, ADFOSC was mounted from Feb 1 to Feb 15 / 15 nights, the ADFOSC from Feb 16 – Mar 31 / 45 nights, and the TANSPEC from May 6 - May 31 / 26 nights. Overall, the 2024-C1 observations were performed successfully with a technical downtime of less than five percent.

4. Maintenance and upgradation works

Telescope health during monsoon period: During the monsoon period at Devasthal from June to September 2023, the telescope needs to be protected from rain and high humidity; hence, the telescope was parked, and it was not made available for science observations. The monsoon period is also used for any maintenance and upgrades of the telescope. The gaps between rotating and non-rotating parts are filled with foam, and dehumidifiers are installed inside the building. A few parts of the telescope, viz azimuth, altitude, rotator, adapter, sensor arm focus and turntable, M2 hexapod, and M1 mirror, need to be moved fortnightly to keep good health of the telescope. The health of the telescope was recorded and checked on about half a dozen occasions during the monsoon period.

Annual maintenance of telescope: ARIES performed the annual maintenance of the 3.6m telescope during the last week of September 2023. A technical issue with the telescope was encountered while performing an on-sky test on the night of Oct 5, 2023, and after a bit of investigation, it was found that the M1 Mirror AFP-1 pad had been unglued. This pad has been unglued for the fourth time. A software solution to the issue was found within a week, and the re-gluing of the M1 pad is scheduled to be held during April 2024. The sanity checks of the telescope, mechanical verification and on-sky tests were performed. The tracking and optical performances of the telescope were found to be at par with the original specifications. The ADFOSC was mounted immediately after telescope tests. The telescope was released to the community in October 2023.

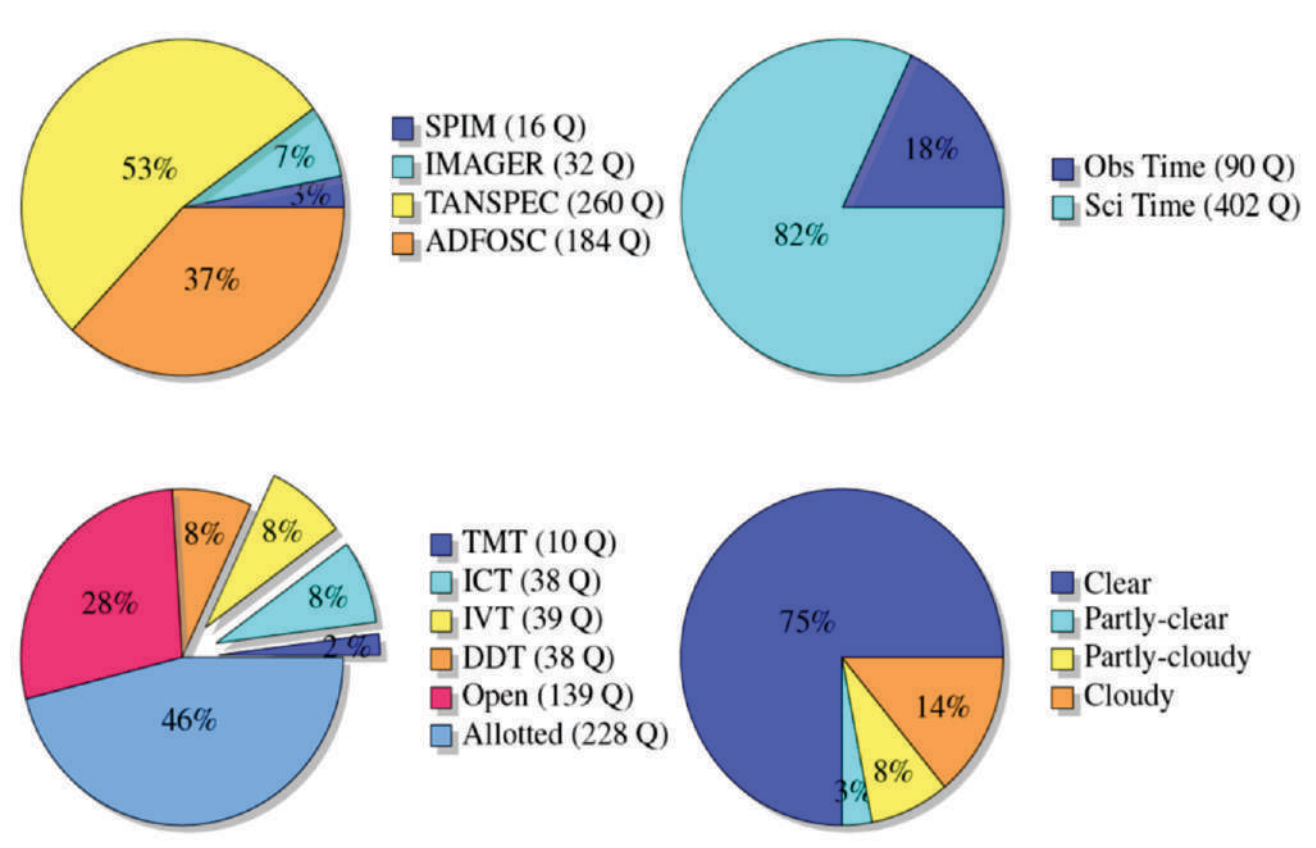

Figure 55. Statistics for Mounting of main axial-port instruments, availability of time, DTAC-approved allocation and clear sky statistics for cycle DOT-2023-C2.

Guider camera: The electrical, mechanical and optical interface with a camera compatible with the guiding unit has been made ready by the ARIES Team and integrated with the telescope; however, integrating the guiding camera into the telescope requires software-related feedback from AMOS. A generic software that can be developed to integrate any camera with a telescope needs to be developed jointly.

Upgrade of 3.7m coating plant: The M1 mirror is coated with bare aluminium, and the reflectivity of the 3.6m mirror is difficult to maintain due to the presence of dust and humidity at the site. Even after the best efforts of dry CO2 cleaning, the reflectivity of the mirror falls about 15-20% per year, and this compels bare Al coating of the M1 mirror every alternate year since 2015. Several factors contribute to this degradation, and a detailed discussion was held during the DOMU meeting. One

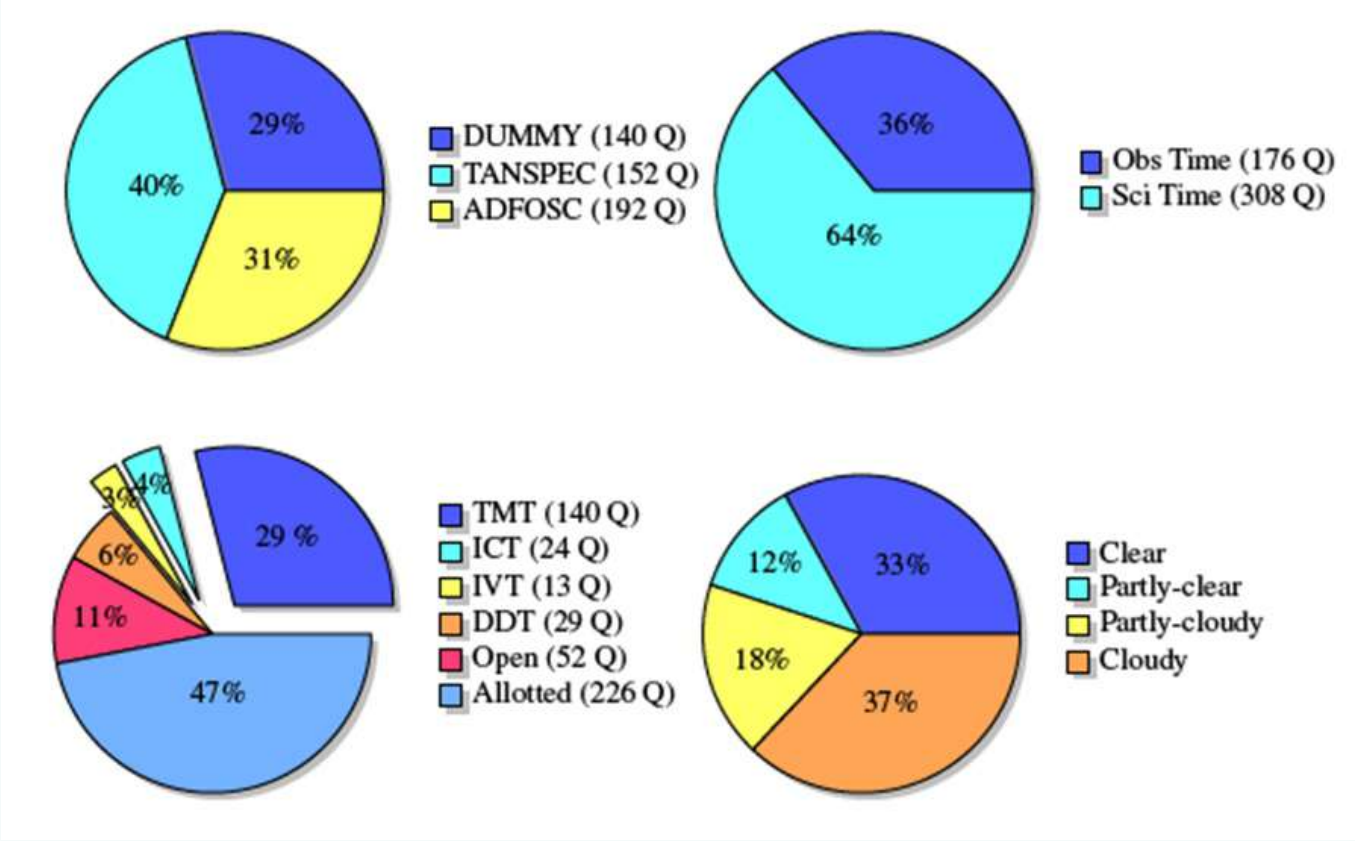

Figure 56. Statistics for mounting of main-port instruments, availability of time and DTAC-approved allocation and clear sky statistics for cycle DOT-2024-C1.

of the possible solutions to this problem is to coat the M1 mirror with a protective Aluminum. There is a plan to upgrade the existing coating plant.

Upcoming Instruments on DOT

High Resolution Spectrograph for DOT (DOT-HRS)

DOT-HRS is a fiber-fed high-resolution spectrograph for the DOT **(Figure 57)**. The spectrograph is being built in collaboration with Australian Astronomical Optics (AAO). Currently, it is in the manufacturing phase. The design of the spectrograph is based on the white pupil configuration with a prism cross disperser to record the specified wavelength range from 380-850 nm on one large-size detector in a single exposure. DOT-HRS offers two observation modes, namely high resolution and low resolution, to cater for a variety of science requirements. The spectrograph aims at high precision radial velocity measurement and simultaneous recording of object + calibration or object + sky spectra. The spectrograph will be housed in a vacuum tank inside a thermally controlled enclosure to achieve the required instrument stability.

The following milestones have been completed in the past year:

- Long-lead items have been successfully acquired,

completing the significant milestone. These items include critical components such as gratings, prism blanks, camera glass blanks, and the collimator.

- The Final Design Review (FDR) was successfully conducted on August 29th and 30th, 2023. This review took place in a hybrid format, with three members from AAO (Ms Celestina Lacombe, Dr Tobias Feger, and Mr Jurek Brezeski) visiting ARIES in person. The remaining AAO members and review committee members participated remotely. The FDR committee presided over by Prof. Eswar Reddy from IIA Bengaluru, consisted of several esteemed individuals, including Prof. S. N. Tandon from IUCAA Pune, Prof. D. K. Ojha from TIFR Mumbai, Prof. Hans Van Winckel from KU Leuven, Prof. T. Sivarani and Mr. S. Sriram from IIA Bengaluru, Mr. Jayshreekar Pant and Dr. J. C. Pandey from ARIES, all of whom played a pivotal role in reviewing the final design. ARIES faculty members actively contributed to the design review process, enhancing its depth and quality.
- A 3-ton capacity jib crane has been installed inside the telescope pier to facilitate the spectrograph assembly.
- A cable anti-twister system has been designed, fabricated and tested to route the optical fiber from the telescope side port to the spectrograph slit.

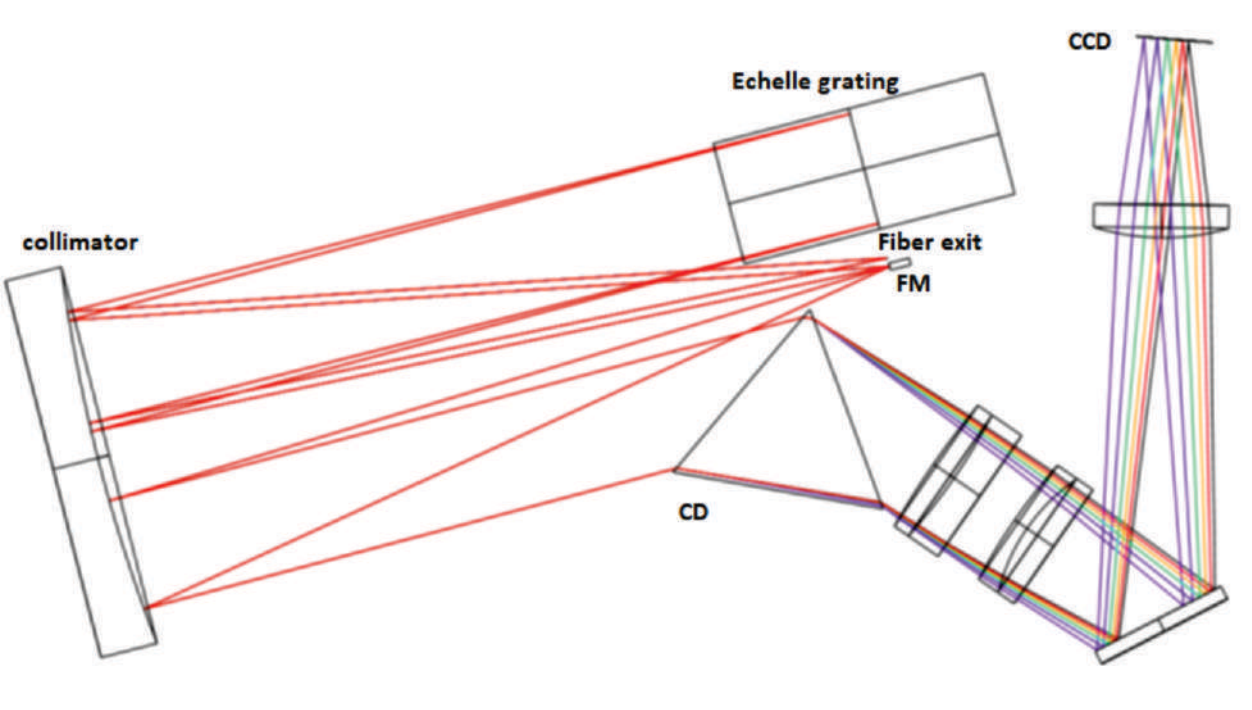

Figure 57 . Optical layout of DOT-HRS.

- The concept design of the thermally controlled room has been prepared, and the fabrication process has been initiated.

Side Port IMager (SPIM)

The DOT has one axial main port and two side ports. Currently, the main port and only one side-port (for NIR imager TIRCAM-2) are engaged with instruments. Main port instruments are TANSPEC (NIR imager and spectroscopy), ADFOSC (optical imaging and spectroscopy), and 4k × 4k Imager (optical). Therefore, an optical imaging instrument on the other side port is critical, especially when TANSPEC is mounted on the main port. The SPIM has been designed in-house for observations using both broad band and narrow band filters. Its filter wheel can hold up to 16 filters at a time. The necessary optical filters, including the narrow-band filters, are already available at ARIES. With a wavelength range of 350-1000 nm and both broadband and narrowband imaging ability, SPIM is well-suited for studying star-forming regions, star clusters, transient sources, active galactic nuclei, variable stars, and more.

One of the most exciting features of the SPIM is the ability to accommodate two CCDs on a rotating plate simultaneously. A new 4k × 4k ANDOR CCD has been installed on SPIM. The CCD can be thermo-electrically cooled to -80°C. With a pixel size of 15 micrometre, it offers a field of view of ~6.5 × 6.5 arcmin^2. It has a peak quantum efficiency of > 95% and multiple readout speed modes (0.1, 1, 2, 4 MHz).

SPIM was mounted on the DOT in October 2023 **(**refer **Figure 38)**, and 3 nights were allocated for its testing in November 2023 **(Figure 58)**. A pointing model was created and sky frames were captured after installing the baffle to check for ghost

Figure 58. Three-color composite image (B, R,I filters) of the Orion Nebula cluster taken with the SPIM instrument mounted on the side port of the DOT.

images. No ghosts were observed in the images. Calibration tests were conducted, including filter movement tests and bias stability. Additionally, CCD characterization, photometric calibration, and site characterization (extinction coefficient calculations) were performed. An issue with the filter movement was identified, which will be addressed through filter gear replacement. A new GUI for filter control is under development and the exposure time calculator is available. SPIM will likely be remounted during June 2024 to complete all the tests after the gear replacement.

4m International Liquid Mirror Telescope (ILMT)

The 4m ILMT is a multi-lateral collaboration between India, Belgium and Canada. The reflective surface of liquid Mercury forms the paraboloid primary mirror of the telescope. The telescope continuously scans a ~22' strip of the sky to survey the zenith sky in SDSS g', r' and i' filters. After the successful first light in April 2022, regular observations are undertaken with the telescope.

The essential telescope components, such as air bearing, metallic structure, optical corrector, CCD camera, mercury pumping system, etc., are present in the main enclosure. Two air compressors and two air tanks are installed in parallel mode for an uninterrupted air supply to the air bearing. The telescope control unit, Socabelec panel (an interface to control the filter movement and focus change), local data server and mercury monitors are installed inside the data acquisition room. The ILMT prime-focus assembly includes a 4k×4k pixel shutter-less CCD camera, a filter slide, and a five-lens TDI-compensating optical corrector. The smooth running of the telescope is accomplished by a 120 kVA UPS providing an uninterrupted power supply.

Proper safety measures were ensured before handling liquid mercury. Specialised masks with an end-of-life indicator, PPE suits, hand gloves, etc., were secured by the personnel entering the telescope floor to handle the mercury. The major preparatory activities before forming the ILMT mirror included thoroughly cleaning and levelling the bowl, azimuth alignment of the primary mirror with respect to the air bearing, vertical run-out verification of the bowl and Mylar installation. The alignment procedure was repeated several times during the day to achieve an accuracy of around 2 arcsec. The Mylar film was carefully installed

across the bowl using adhesive tape around the periphery before forming the mirror. A mercury pumping system transferred approximately 50 litre of mercury to the bowl from the storage tank. The mirror control system was engaged to rotate the mirror at its nominal angular rate. The mercury is spread uniformly across the bowl by imparting slight acceleration and deceleration to the mirror with a handheld push button. After the mirror stabilised, sky tests were performed. Focus adjustment was done to obtain sharper images. A significant light gradient was noticed on the frames, most likely due to some light leakage in the dome. An experiment to cover the walls of the telescope enclosure with black foam was conducted but was unsuccessful. The best stellar profile achieved so far was on the images of 8 February 2024 with a full width at half maximum (FWHM) of 1.22 arcsec **(Figure 59)**.

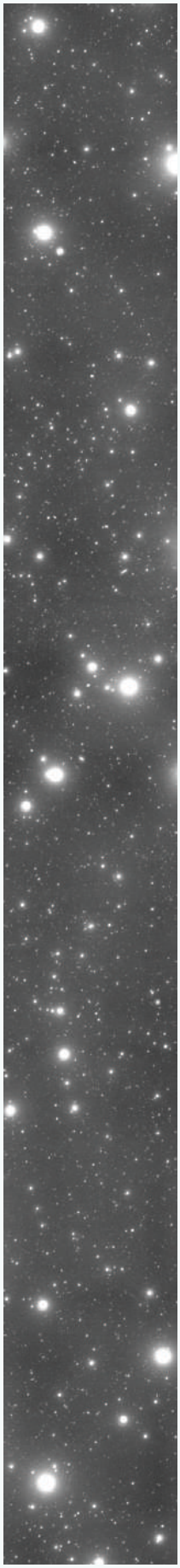

Figure 59. The i'-band ILMT frame with the best stellar profile (FWHM 1.22 arcsec) achieved so far on 8 February 2024.

Wobbling tests were performed to enhance the image quality further by attaching additional weights to the periphery of the bowl, which led to success. Dust removal from the mylar sheet was performed carefully during the observing period.

Throughout the monsoon period, when the telescope was closed for scientific observations, routine maintenance activities continued, with particular attention paid to monitoring mercury vapour counts, vacuuming the CCD, lubricating critical mechanical parts, servicing the compressors, etc.

The telescope surveys a zenithal strip of the sky at the same local sidereal time fields for several consecutive months. This unique feature of the ILMT makes it a useful instrument for time-domain astronomy, especially for detecting transients, variable stars, active galactic nuclei, and asteroids. The ILMT team has developed a Python-based transient detection pipeline, PyLMT, to detect such transient/varying sources in the ILMT images in near real-time. The pipeline essentially compares a pair of images from the same field using the image subtraction technique to find such sources in the subtracted images using a convolutional neural network (CNN). It also houses a CNN-aided transient candidate classifier that classifies the transient/variable candidates based on host morphology. The pipeline compares asteroids and other solar system objects using public databases for their identification. The initial results from the pipeline have been encouraging, resulting in the detection of several extragalactic transients. A full paper on this is being prepared.

The data acquired in October-November 2022 (Data Release 1) and March-June 2023 (Data Release 2) have been publicly released and available for download to the scientific community in the raw format and astrometrically calibrated using the custom pipeline (https://cloud.aries.res.in/ index.php/s/xPER9Y3XuaCsTL9). The posters presented during the third BINA workshop were accepted for publication as proceeding papers in the Bulletin of Liège Royal Society of Sciences.

1.3m Devasthal Fast Optical Telescope (DFOT)

The 1.3m Devasthal Fast Optical Telescope (DFOT), located in Devasthal, India, has been operational for over a decade and is the primary facility for conducting photometric observations for various scientific programs at ARIES. The facility is equipped with two CCD imagers as back-end instruments, including a 2k × 2k

pixels imager and a 512×512 pixels frame transfer imager, which can be utilised interchangeably based on the specific requirements of the observer. With the capability to achieve sub-millimag photometric stability, the system enables the detection of minute photometric variations.

The DFOT currently features a filter assembly capable of accommodating eight filters simultaneously, including 13 broadband and narrowband (UBVRI, ugriz, Hα, SII, OIII) optical filters. Additionally, the facility has an auto-guider unit, an all-sky camera, and a GPS-enabled weather monitoring system to support observations. The main scientific programs conducted with the DFOT encompass the monitoring of transients such as GRBs, supernovae, exoplanets, and occultations, variability studies in star clusters and the Galaxy, episodic events including AGN and X-ray binaries, as well as optical imaging of open and globular star clusters and the study of galaxies etc.

The proposals for observing with the DFOT were subject to evaluation by the Joint Time Allocation Committee (JTAC). A total of 237 observing nights were allocated for 2023-24. Of these, scientific data was successfully collected on 169 nights; 67 nights were lost due to adverse weather conditions, and one night was lost due to a technical issue. Furthermore, utilising DFOT observations, more than 15 research articles were published in prominent academic journals, and a substantial number of scientific circulars and conference proceedings were published.

Regular preventive maintenance activities were carried out during the monsoon period and the observing season. The cleaning of the mirror was conducted in September 2023, resulting in the achievement of the desired reflectivity. To enhance the telescope's capabilities, significant upgrades, such as modifications to the filter unit to minimise filter change time, as well as upgrades to the telescope electronics, including the Telescope Control System (TCS), and the acquisition of a large format 4k × 4k CCD, are planned for the near future.

104cm Sampurnanand Telescope (ST)

The 104-cm telescope is being used for imaging and polarimetry of celestial sources. The joint time allocation committee (JTAC) invited observing proposals twice in observing cycles 2023-B and 2024-A during 2023-24. A total of 12 and 150 observing proposals were received. Since the telescope time was under subscription, all the proposals were considered for observing times and a total of 168 nights were allocated. However, useful data could be obtained only on 112 nights. The majority of the nights were lost due to bad weather conditions. The raw data is stored in a centralised storage. The data acquired from the 104-cm telescope was used in 8 research papers in international journals and several conference proceedings. Upgradation of the 104 cm telescope has been planned. As an initiative, a guiding camera has been procured and its laboratory test has been completed. The on-sky test will be conducted in October 2024.

ARIES Stratosphere Troposphere Radar (ASTRAD)

ARIES successfully operates the 206.5 MHz ST Radar (ASTRAD) which is designed and developed in India. ASTRAD is capable of measuring the 3D wind-field up to the lower stratosphere (~30 km). In addition to regular observations by ASTRAD, extensive campaign mode observations with other similar radars in the country are undertaken. During the year, several developmental and maintenance activities were taken up to ensure its smooth operation in future.

The Phase 1 upgrade of one cluster of 49 TRMs with in-house designed and fabricated high-power amplifiers (HPAs) has been successfully completed. All 49 high-power amplifier (HPA) modules were integrated into the existing 49 TRMs in place of old HPAs. Subsequently, these upgraded TRMs were integrated into clusters. Post-integration, the performance of all TRMs was verified by capturing wind information. **(Figures 60).**

The annual calibration process of the active aperture of the ASTRAD was completed successfully. After calibration, the system's performance was evaluated by capturing atmospheric wind information. One observation during a western disturbance (WD) episode on 3 March 2024 is shown in **Figure 61**. This observation captured the wind speed of the Subtropical Westerly Jet (SWJ) embedded in the WD, with speeds exceeding 230 km/hr.

Spare TRMs **(**top panel, **Figure 62)** and folded dipoles **(**bottom panel, **Figure 62)** for ASTRAD have been produced in-house through design, fabrication, integration, and testing processes. These efforts will contribute to the smooth operation of the radar system, minimising downtime for major subsystems (antenna and TRM) and leveraging in-house technical capabilities.

Planned procurement of spare components and instruments has been completed, aligning with the projections made at

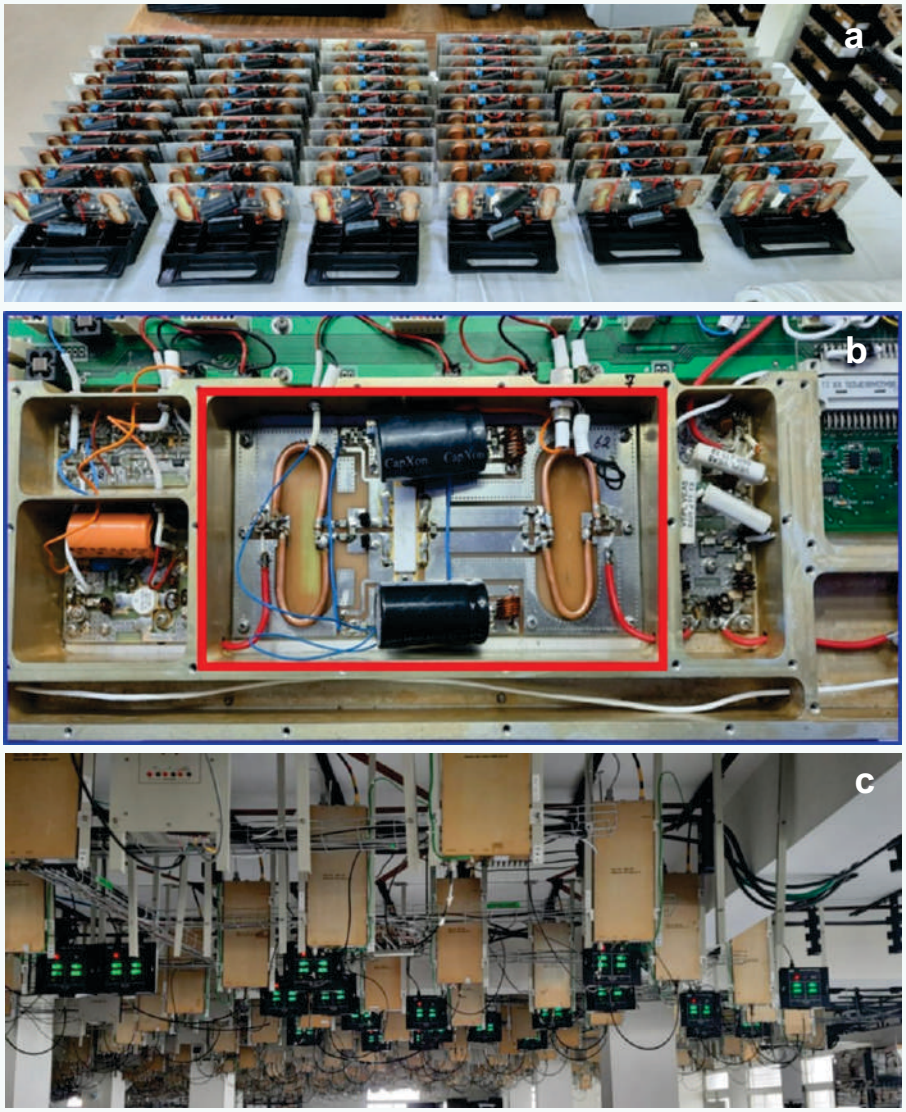

Figure 60 . (a) In-house fabrication of new High Power Amplifier (HPA) for ASTRAD's TRM; (b) Integration of new HPA in TRM; (c) Integration of TRM with new HPA with in-house designed SMPS-based dual DC Power Supply Unit in active aperture.

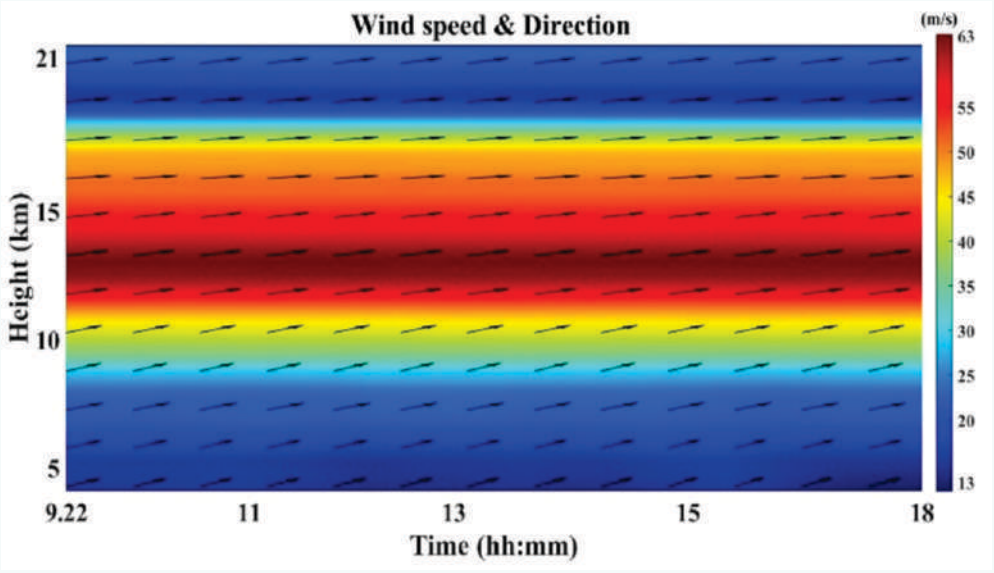

Figure 61. Western Disturbance episode observation on 3 March 2024 after calibration of the Radar.

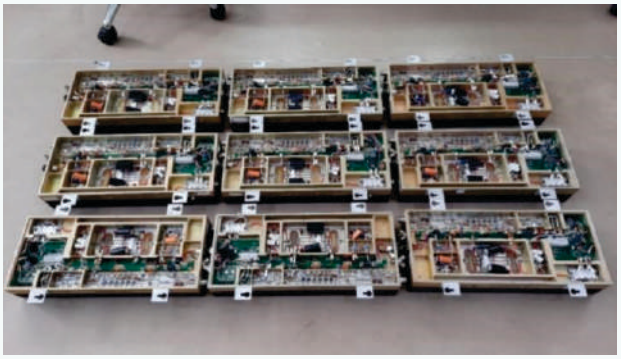

Figure 62. (Top) In-house production of spare TRMS; **(Bottom)** Integration of in-house design, fabricated folded-dipole in one sub array of ASTRAD active aperture.

the beginning of the last financial year. Radar operations continued smoothly, catering to scientific requirements within and outside the institute.

New Atmospheric Instruments

Recently, ARIES has installed a PANDORA spectrometer **(Figure 63)** for observations of a few trace gases over the Central Himalayas. A ground-based UV-visible remote-sensing instrument, it is used for the retrieval of columnar NO_2, HCHO, O_3 and SO_2. An additional PANDORA instrument is also being set up in the Haldwani transit campus. Its observations are useful for validating the space-based UV-VIS sensors and understanding the local air quality as well.

Figure 63. (Top) The telescope for the PANDORA instrument along with **(Bottom)** spectrometer, operational at the atmospheric sciences building of ARIES, Nainital.

Aditya-L1 Support Cell (AL1SC)

Aditya-L1 mission, India's first dedicated solar space mission, was launched on 2 September 2023. AL1SC, a joint effort of ARIES with ISRO, will act as a community service centre for the guest observers in preparing science observing proposals and analysing science data. This support cell regularly conducts workshops to train MSc/ Int. MSc/ Int. PhD/ BTech/ MTech students in solar physics, space weather, current open problems, the Aditya-L1 mission, and observational data analysis techniques. During the last year 3 workshops were conducted, the details of which are given in the table below.

AL1SC will be conducting more such workshops with real data from the mission to help create a larger user pool and further develop the solar physics community in the country.

Sl No.	Dates	Workshop Conducted	Organising Unit	Venue	No. of Participants
1	28 June - 7 July, 2023	4th AL1SC workshop	ARIES & ISRO	ARIES, Nainital	40
2	29 September - 1 October, 2023	5th AL1SC workshop	ARIES, ISRO and IIT Kanpur	IIT, Kanpur	51
3	6-8 February, 2024	6th AL1SC workshop	ISRO & JECRC University	JECRC University, Jaipur	43

Table 1. Summary of AL1SC workshops during 2023-24.

Academic Programmes of ARIES

The Academic Committee (AC) is dedicated to improving the academic environment at ARIES by overseeing the academic affairs of research students. The current members of the committee are:

Dr. Yogesh C. Joshi (Chair)

Dr. Manish Naja (Co-Chair)

Dr. Indranil Chattopadhyay

Dr. Saurabh

Dr. Kuntal Misra

Dr. Vaibhav Pant

Dr. Suvendu Rakshit

Mr. Ramdayal Bhatt serves as the AC Secretary, managing official student files, and academic related matters of the students.

Major Activities of the Academic Committee:

[1] Syllabus Preparation and Course Management The AC is responsible for preparing and managing the pre-Ph.D. coursework for ARIES. The syllabus is periodically updated to align with the requirements of affiliated institutes and universities, while maintaining its core structure.

[2] Joint Entrance Screening Test (JEST) The AC played a key role in planning the JEST examination at the national level. ARIES Committee members were responsible for overseeing the conduct of JEST those were held at the Roorkee and Haldwani centers in February 2023.

[3] Ph.D. Entrance Interviews The AC organizes interviews annually to select Ph.D. students for JRF positions at ARIES. Applications were screened, and interviews took place from July 3-7, 2023, and December 11-12, 2023. Candidates with M.Sc. degrees in Physics/Astrophysics who qualified JEST/NET/GATE, as well as Inspire-qualified candidates meeting general criteria, were invited. Successful candidates were selected as JRFs and began pre-Ph.D. coursework at ARIES. Nine students joined ARIES:

Mr. Divyanshu Janghel

Mr. Manojit Chakraborty

Ms. Archana Kumari

Mr. Akhilesh Ray

Mr. Dhruv Jain

Ms. Debalina Kar

Mr. Prakhar Singh

Mr. Sunil Kumar

Mr. Mahadev A V

Two additional students joined ARIES under National projects:

Mr. Surath Chandra Ghosh (BINA)

Mr. Mukesh Kumar (ISRO-ATCTM)

[4] Integrated M.Tech-Ph.D. (Tech.) Programme The Integrated M.Tech-Ph.D. (Tech.) programme in Astronomical Instrumentation, in collaboration with the Department of Applied Optics and Photonics at the University of Calcutta, commenced at ARIES. The M.Tech course spans two years and consists of four semesters. Upon successful completion, students may register for the Ph.D. (Tech.) programme, subject to selection procedures and minimum grade requirements. Eligible candidates included those with B.Tech. degrees in relevant fields or M.Sc. degrees from recognized institutions. Interviews were conducted during 10-11 July 2023, and two students joined the programme:

Mr. Tushar Gajanan Ubarhnde

Mr. Kartik Ghanshyam Gokhe

[5] Summer Project Students The summer project internship is a key initiative of the AC, offering short and long-term training programs to undergraduate and master's level students from various institutions. A total of 52 students completed short-term projects at ARIES during 2023-2024.

[6] Ph.D. Student Reviews The AC organizes reviews for first-year Ph.D. students upon completion of their

coursework. In August 2023, the AC conducted examinations and project presentations for the first-year students. The following students successfully completed their pre-Ph.D. coursework and advanced to the main Ph.D. program:

Mr. Rohan Bose

Mr. Rishi C

Mr. Ashutosh Tomar

Mr. Bablu Mandal

Ms. Khushboo Sharma

Ms. Anshika Gupta

Ms. Mamta

The AC also facilitated reviews for senior research students, including those promoted from Junior Research Fellow (JRF) to Senior Research Fellow (SRF). The following students were promoted based on an open review and comprehensive examination of their coursework:

Mr. Tarak Chand

Mr. Vikrant Tomar

Mr. Priyesh Kumar Tripathi

Mr. Srinivas M Rao

Ms. Ambika Saxena

Ms. Monalisa Dubey

Mr. Karan Dogra

Ms. Srinjana Rauth

[7] Post Doctoral Fellows/Research Associates Fifteen Post Doctoral Fellows (PDFs) and Research Associates (RAs) were joined ARIES during 2023-2024.

[9] M.Tech. Degrees Two students from ARIES were awarded or defended their M.Tech. degrees during 2023-2024.

Awarded

Kumar Pranshu defended his Mtech thesis titled "Automated transient detection in the context of the 4m International Liquid Mirror Telescope" to the University of Calcutta in July 2023. The research was done under the supervision of **Kuntal Misra.**

Purvi Udhwani defended her Mtech thesis titled "Evaluation and correction of slowly-varying seeing components at ARIES telescopes" to the University of Calcutta in July 2023. The research was done under the supervision of **Amitesh Omar** & **Krishna Reddy.**

[8] Ph.D. Theses Sixteen students from ARIES were awarded or defended their Ph.D. degree and one student submitted his Ph.D. thesis during 2023-2024 **(Figure 64)**.

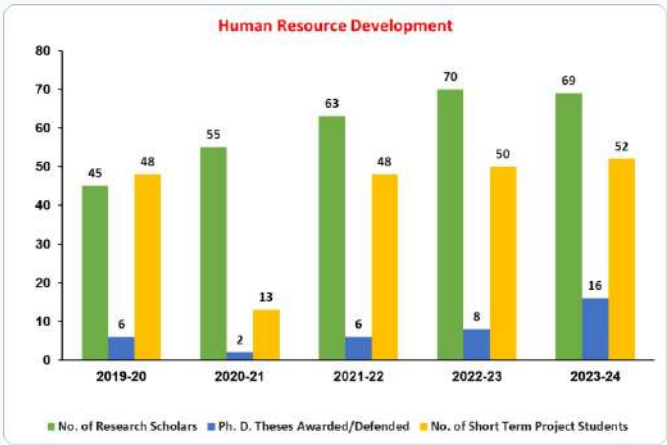

Figure 64. Human resource development indicators from ARIES during the last five years.

Awarded/Defended

Aditya Jaiswal was awarded Ph.D. degree in February 2024. His thesis titled "Investigation of Dynamical Aspects of the Atmosphere Over Central Himalayas Using ST Radar and Other Observations" was submitted to the Deen Dayal Upadhyaya Gorakhpur University, Gorakhpur. He carried out this work under the supervision of **Manish Naja** & Sugriva Nath Tiwari.

Amar Aryan defended his Ph.D. degree in December 2023. His thesis titled "Unveiling diverse nature of core collapse supernovae" was submitted to the Deen Dayal Upadhyaya Gorakhpur University, Gorakhpur. He carried out this work under the supervision of **Shashi Bhushan Pandey** & Sugriva Nath Tiwari.

Ankur Ghosh was awarded Ph.D. degree in August 2023. His thesis titled "Study of GRBs-on Aspects of Multi-Wavelength Emission, Environment and Host Galaxies" was submitted to the Pt. Ravishankar Shukla University, Raipur. He carried out this work under the supervision of **Amitesh**

Omar & Nand Kumar Chakradhari.

Arpan Ghosh defended his Ph.D. degree in July 2023. His thesis titled "Multiwavelength spectro-photometric monitoring of episodically accret-ing young low-mass stars" was submitted to the Pt. Ravishankar Shukla University, Raipur. He carried out this work under the supervision of **Saurabh** and Anubha S. Gour.

Dimple defended her Ph.D. degree in February 2024. Her thesis titled "Multi-wavelength Studies of Gamma Ray Bursts (GRBs) and Associated Counterparts" was submitted to the Deen Dayal Upadhyaya Gorakhpur University, Gorakhpur. She carried out this work under the supervision of **Kuntal Misra** & Lallan Yadav.

Jayanand Maurya was awarded Ph.D. degree in April 2023. His thesis titled "Photometric, kinematic, and variability study in the galactic open clusters" was submitted to the Pt. Ravishankar Shukla University, Raipur. He carried out this work under the supervision of **Yogesh C. Joshi** and Anubha S. Gour.

Jaydeep Singh was awarded Ph.D. degree in January 2024. His thesis titled "Observation and modelling studies on meteorology over Central Himalaya was submitted to the Deen Dayal Upadhyaya Gorakhpur University, Gorakhpur. He carried out this work under the supervision of **Narendra Singh** and Prof. Ravi Shankar Singh.

Krishan Chand defended his Ph.D. degree in December 2023. His thesis titled "Transitions and persistence of blazar state in beamed radio quasars" was submitted to the Kumaun University, Nainital. He carried out this work under the supervision of P. S. Bisht and **Amitesh Omar**.

Nikita Rawat defended her Ph.D. degree in February 2024. Her thesis titled "Accretion Flows in Magnetic Cataclysmic Variables" was submitted to the Deen Dayal Upadhyaya Gorakhpur University, Gorakhpur. She carried out this work under the supervision of **Jeewan Chandra Pandey** & Umesh Yadava.

Prajjwal Singh Rawat was awarded Ph.D. degree in December 2023. His thesis titled "Variabilities in Trace Gases and Meteorological Parameters over the Himalayan and Associated Regions" was submitted to the Deen Dayal Upadhyaya Gorakhpur University, Gorakhpur. He carried out this work under the supervision of **Manish Naja** & Sugriva Nath Tiwari.

Rahul Gupta defended his Ph.D. degree in December 2023. His thesis titled "Multiwavelength observations of gamma ray bursts" was submitted to the Deen Dayal Upadhyaya Gorakhpur University, Gorakhpur. He carried out this work under the supervision of **Shashi Bhushan Pandey** & Sugriva Nath Tiwari.

Raj Kishor Joshi defended his Ph.D. degree in March 2024. His thesis titled "Numerical Simulations of Fluid Flows Around Compact Objects" was submitted to the Deen Dayal Upadhyaya Gorakhpur University, Gorakhpur. He carried out this work under the supervision of **Indranil Chattopadhyay** & Lallan Yadav.

Sadhana Singh defended her Ph.D. degree in June 2023. Her thesis titled "Dust properties towards galactic anti-center direction" was submitted to the Pt. Ravishankar Shukla University, Raipur. She carried out this work under the supervision of **J. C. Pandey** and Yugal K. Mahipal.

Vibhore Negi defended his Ph.D. degree in February 2024. His thesis titled "Extragalactic Astrophysics Using 4m International Liquid Mirror Telescope" was submitted to the Deen Dayal Upadhyaya Gorakhpur University, Gorakhpur. He carried out this work under the supervision of **Hum Chand** & Ravi Shankar Singh.

Vinit Dhiman was awarded Ph.D. degree in October 2023. His thesis titled "Optical and X-ray Studies of TeV Blazars" was submitted to the Pt. Ravishankar Shukla University, Raipur. He carried out this work under the supervision of **Alok C. Gupta** and D. P. Bisen.

Vivek Kumar Jha defended his Ph.D. degree in February 2024. His thesis titled "Investigating the Nature and Structure of Broad Line Regions in Active Galactic Nuclei" was submitted to the Deen Dayal Upadhyaya Gorakhpur University, Gorakhpur. He carried out this work under the supervision of **Hum Chand** & Shantanu Rastogi.

Submitted

Alaxender Panchal submitted his thesis titled "Photometric and Spectroscopic studies of low mass eclipsing binary and exoplanet candidates" to the Deen Dayal Upadhyaya Gorakhpur University, Gorakhpur in September 2023. The research was done under the supervision of **Yogesh Chandra Joshi** & Sugriva Nath Tiwari.

Talk/Poster presentations delivered by research scholars and PDFs

Aayushi Verma

Exploring stellar cluster and feedback-driven star formation in the galactic mid-infrared bubble [HKS2019] E70, 08 - 11 January, 2024, , 4th Meeting on Star Formation Studies in India, S. N. B. C. B. S., Kolkata. *(Talk)*

Ambika Saxena

Exploring spectral line asymmetries due to the propagating MHD waves in the solar atmosphere, 13 – 15 July, 2023, 3rd Conference on Plasma Simulation, Raman Science Center, IIA, Leh, Ladakh. *(Poster)*

Investigating spectral line asymmetries due to the propagating MHD waves in the solar atmosphere, 31 January - 04 February 2024, 42nd Meeting of the Astronomical Society of India, IISc Banglore. *(Poster)*

Athul Dileep

Variability in Chemically peculiar stars and Open clusters, 10 October 2023, BINA/BIPASS MEETING: "Evaluation and future prospects of the Indo-Belgian collaboration", ROB, Belgium. *(Talk)*

Arjun Dawn

Experimental evaluation of scientific CMOS camera for night-time Astronomy, 01 - 04 November, 2023, META 2023, RRI, Bengaluru. *(Talk)*

Bharati Paul

Investigating the relationships between meteorological environment and forest fires of the Central Himalayas, 22 – 24 November, 2023, National Symposium on Tropical Meteorology TROPMET 2023 BIT, Jaipur. *(Talk)*

Impact of land use land cover change on PM2.5 concentration and meteorological environment over the Delhi Metropolitan, 26 February - 01 March, 2024, NSSS-2024, Goa University. *(Poster)*

Bhavya

SN 2020jfo: A short-plateau Type II SN, 28 August - 01 September, 2023, Technion Israel Institute of Technology, Haifa, Israel. *(Talk)*

An automated photometric pipeline for the ILMT data, 16 - 19 October, 2023, BRICS 2023, SAAO, South Africa. *(Poster)*

An automated photometric pipeline for the intensive ILMT data, 01 - 04 November, 2023, META 2023, RRI, Bengaluru. *(Talk)*

Unveiling the characteristics of Fast-declining Type IIP SN 2020aze, 06 - 10 November, 2023, Supervitrual 2023. *(Poster)*

Dibya Kirti Mishra

CaK polar network as a proxy for estimating polar magnetic fields, 26 February - 01 March, 2024, NSSS-2024, Goa University. *(Talk)*

19 - 23 December, 2023, Winter School on the concepts of Solar physics, New Delhi. *(Participant)*

Divya Pandey

Probing the star-formation activities of galaxies residing in void and filaments using AstroSat, 31 January - 04 February 2024, 42nd Meeting of the Astronomical Society of India, IISc Banglore. *(Thesis Presentation)*

Jincen Jose

15 June - 17 June, 2023, Workshop on " Black Holes : theory and observation", IIA, Banglore. *(Participant)*

The Gamma-ray emitting NLS1 1H023+342 : A Spectropolarimetric view, 31 January - 04 February 2024, 42nd Meeting of the Astronomical Society of India, IISc Banglore. *(Talk)*

Jyoti Sheoran

Evolution of the thermodynamic properties of a Coronal Mass Ejection in the inner corona, 03 - 05 April, 2023, USO-PRL Solar Physics Workshop, USO, Udaipur. *(Poster)*

Investigating the evolution of thermodynamic properties of a Coronal Mass Ejection in the inner corona, 29 August - 01 September, 2023. First UCoMP user Workshop, High Altitude Observatory (HAO), Boulder, CO. *(e – Talk)*

Khushboo Sharma

Diffuse Neutrino Flux from Choked and Low Luminosity GRBs, 31 January - 04 February 2024, 42nd Meeting of the

Astronomical Society of India, IISc Banglore. *(Poster)*

Kiran Wani

Studies of Variability Mechanism in Blazar Jets using X-ray Data, 03 - 05 April, 2023, REcent Trends in Compact Objects (RETCO-V), KSO, Kodaikanal. *(Poster)*

Kumar Pranshu

Automated transient detection in the context of the 4m International Liquid Mirror Telescope (ILMT), 16 - 19 October, 2023, BRICS 2023, SAAO, South Africa. *(Poster)*

Automated transient detection in the context of the 4m International Liquid Mirror Telescope (ILMT), 01 - 04 November, 2023, META 2023, RRI, Bengaluru. *(Talk)*

Automated transient detection in the context of the 4m International Liquid Mirror Telescope (ILMT), 05 December, 2023, BRICS multimessenger astronomy conference 2023, Russia. *(e-talk)*

CNN based classification of transient alerts for the 4-m International Liquid Mirror Telescope, 31 January - 04 February 2024, 42nd Meeting of the Astronomical Society of India, IISc Banglore. *(Poster)*

Mamta

Deep near-infrared imaging of young embedded star cluster BDS2003-52, 08 - 11 January, 2024, 4th Meeting on Star Formation Studies in India, S. N. B. C. B. S. , Kolkata. *(Poster)*

Deep near-infrared imaging of young embedded star cluster BDS2003-52, 31 January - 04 February, 2024, 42nd Meeting of the Astronomical Society of India, IISc Banglore. *(Poster)*

Monalisa Dubey

Exploring the progenitor properties of Type IIP CCSNe - SN 2018pq, 06 - 10 November, 2023, SuperVirtual 2023. *(Poster)*

Unrevalling the progenitor properties of long-plateau supernovae, 31 January - 04 February, 2024, 42nd Meeting of the Astronomical Society of India, IISc Banglore. *(Talk)*

Nikita Rawat

Swift J0503.7-2819: A nearly synchronous intermediate polar below the period gap?, 03 - 05 April, 2023, REcent Trends in Compact Objects (RETCO-V), KSO, Kodaikanal. *(Talk)*

Swift J0503.7-2819: A nearly synchronous intermediate polar below the period gap?, 19 - 23 June, 2023, First Vasto Accretion Meeting (VAM), Vasto, Italy. *(Talk)*

Swift J0503.7-2819: A nearly synchronous intermediate polar below the period gap?, 05 – 08 September, 2023, 5th International Workshop on AM CVn Binaries, Armagh Observatory & Planetarium, Northern Ireland, UK. *(e-Talk)*

Pritam Das

Dynamics of CMEs in the Middle Corona, 31 January - 4 February, 2024, 42nd Meeting of the Astronomical Society of India, IISc Banglore. *(Poster)*

Priyesh Kumar Tripathi

Effect of the fluid composition on the magnetized astrophysical flows, 03 - 05 April, 2023, REcent Trends in Compact Objects (RETCO-V), KSO, Kodaikanal. *(Poster)*

10 - 14 July, 2023, Workshop on 'Computational Astrophysics with PLUTO', IISc Banglore. *(Participant)*

Effect of fluid composition on the Bondi-Hoyle accretion flow, 02 - 04 November, 2023, AReA-2023, ARIES, Nainital. *(Talk)*

Effect of the fluid composition on the Bondi-Hoyle accretion flow, 31 January - 04 February 2024, 42nd Meeting of the Astronomical Society of India, IISc Banglore. *(Poster)*

Rishi C

Influence of radiative feedback in Bright Rimmed Cloud (BRC) 44, 31 January - 4 February, 2024, 42nd Meeting of the Astronomical Society of India, IISc Banglore. *(Poster)*

Study of YSOs and radiative feedback in Bright Rimmed Cloud (BRC) 44, 08 - 11 January, 2024, 4th Meeting on Star Formation Studies in India, S. N. B. C. B. S., Kolkata. *(Poster)*

Sanjit Debnath

Viscous accretion flow around a black hole, 03 - 05 April, 2023, REcent Trends in Compact Objects (RETCO-V), KSO, Kodaikanal. *(Talk)*

Oscillating shocks in the transonic viscous, variable Γ accretion flows around black hole, 02 - 04 November, 2023, AReA-2023, ARIES, Nainital. *(Talk)*

Oscillating shocks in the transonic viscous, variable Γ accretion flows around black hole, 06 - 09 December, 2023, 10th ICGC, IIT Guwahati. *(Talk)*

Srinivas M Rao

Change in accretion flow in an Intermediate Polar V709 Cas, 03 - 05 April, 2023, REcent Trends in Compact Objects (RETCO-V), KSO, Kodaikanal. *(Poster)*

Photometric study of an eclipsing Intermediate Polar: V1460 Her, 31 January - 04 February 2024, 42nd Meeting of the Astronomical Society of India, IISc Banglore. *(Poster)*

Tarak Chand

Photometric study of an open star cluster Be65, 08 - 11 January, 2024, 4th Meeting on Star Formation Studies in India, S. N. B. C. B. S., Kolkata. *(Poster)*

Photometric study of open star cluster Be65, 31 January - 04 February, 2024, 42nd Meeting of the Astronomical Society of India, IISc Banglore. *(Poster)*

Upasna Baweja

Global coronal magnetic field estimation using Bayesian Inference, 29 August - 01 September, 2023, First UCoMP user Workshop, High Altitude Observatory (HAO), Boulder, CO. *(e – Talk)*

19 - 23 December, 2023, Winter School on the concepts of Solar physics, New Delhi. *(Participant)*

Vikrant Tomar

Long-term changes in tropospheric ozone over the Central Himalaya: role of different processes, 08-10 June, 2023,5th ACAM Workshop, Dhaka. *(Talk)*

Long term changes (2007-22) in surface ozone at a high-altitude site in the Central Himalayas, 17 November, 2023, IGAC-iCACGP ECR. *(Poster)*

Long-term changes in tropospheric ozone over the Central Himalaya: role of different processes, 22 – 24 November, 2023, TROPMET 2023, Jaipur. *(Talk)*

Long-term changes in surface ozone over the high altitude site in Central Himalayas: contrasting trends during 2007-2015 and 2016-2022 periods, 26 February - 01 March, 2024, NSSS 2024, Goa. *(Poster)*

Knowledge Resource Centre/Library

Libraries play a vital role in providing people with reliable content. They encourage and promote the process of learning and grasping knowledge. It serves as the foundation for innovation, research, and progress. ARIES Knowledge Resource Center, or KRC **(Figure 65)**, is an invaluable asset for scientists, researchers, students, and anyone with a passion for unravelling the mysteries of the universe. The ARIES KRC provides a wealth of resources that cater to a diverse range of interests and needs of ARIES members.

The ARIES KRC acquires books and journals mainly related to Astronomy & Astrophysics, Atmospheric Sciences and Engineering. The KRC also acquires reference books from time to time. It is facilitated with Wi-Fi connectivity. The KRC is a member of the National Knowledge Resource Consortium (NKRC). NKRC provides free access to subscribed online databases to DST and CSIR institutions. The KRC is responsible for providing reports on the activities of the institute from time to time. The monthly, quarterly and annual reports along with the Key Performance Indicator (KPI) data are prepared and submitted to the DST and other organisations whenever required.

KRC Resource Development

During the period 2023–2024, the following information resources were added:

Subscription to Journals :74 (Full Text Databases)

Publications in refereed journals : 130

Theses awarded : 16

The collection at the end of the period is

Books : 11,141

Bound volumes of Journals : 11,205

Apart from books and journals, other old material such as slides, charts, maps, diskettes, CD-ROMs, etc. are also preserved and archived in the KRC database. The user-friendly features of Online Catalogue are also available at Web-OPAC in the ARIES website. DSpace, an open source software is used for the digital repository of ARIES, where KRC preserves theses, scientific documents, academic reports, photographs of special events, newspaper clippings etc. Stock verification exercise was carried out during November, 2023 to January, 2024.

Figure 65. KRC main reading hall.

ARIES Science Popularisation & Outreach Programme (ASPOP)

ARIES Science Popularization and Outreach Programme (ASPOP) is the institute's commitment in disseminating knowledge in students and society-at-large in a non-technical language. ARIES members regularly deliver popular talks on different forums. For outreach activities ASPOP has dedicated telescopes, a mini planetarium, science exhibits/ movies, etc. in the ARIES Science Centre at Manora Peak. Its renovation has been initiated to improve the visitors' experience. Two Dobsonian telescopes of 8 and 10 inch aperture with computerised tracking were acquired for stargazing activities. A new science centre named after Padma Bhushan Prof. Shri Krishna Joshi was inaugurated at the Devasthal Observatory campus on 9 October, 2023 to further enhance ARIES's outreach efforts **(Figure 66)**. Two project staff were appointed under ASPOP during the year.

National Science Day

National Science Day was celebrated during 16-28 February, 2024 and students from many schools, colleges and universities from nearby places visited ARIES for lectures, tours of observational facilities, stargazing, interaction with scientists, quiz and speech competitions. An open day was arranged on 28 February for the public with similar activities. The ASPOP team also visited a nearby school for sunspot and telescope demonstration on 24 February **(Figure 67)**.

Figure 66. Inauguration of S. K. Joshi Science Centre by Shri A. S. Kiran Kumar, Chairperson, Governing Body, ARIES at Devasthal Observatory.

Figure 67. Glimpses from the National Science Day celebration activities.

Aditya-L1 Launch

A special outreach event along with the live screening of the launch was organised at ARIES on 2 September 2023, the day when Aditya-L1 was launched **(Figure 68)**. Before and after the launch, ARIES members participated in many public outreach and media engagement events in multiple cities across India in association with other science popularisation bodies **(Figure 69)**.

Figure 68. Outreach activities at ARIES on the day of *Aditya-L1* launch.

Exhibitions

ARIES participated in many exhibitions during the year. ARIES and IIA, Bengaluru put up a joint stall at the Government Achievements & Schemes Expo during 21-23 July, 2023 at New Delhi and were awarded the 2nd prize in the exhibition. ARIES also participated in the Diamond Jubilee celebration exhibition organised by DIBER, DRDO at Haldwani during 14-15 October, 2023; Vibrant Uttarakhand 2023 exhibition at Haridwar during 20-22 October, 2023; Uttarakhand State Science and Technology Congress 2024 (USSTC 2024) during 8-9 February, 2024 and Gatisheel Jammu Aur Kashmir… Atmanirbhar Bharat Ki Or during 1-3 March, 2024 at Jammu **(Figure 70)**. Hundreds of students and the general public visited the ARIES stalls in these exhibitions. A curtain-raiser outreach session was conducted at ARIES on 10 January, 2024 as a precursor to the International Science Festival (IISF) 2024. ARIES was also a part of the DST pavilion in the IISF 2024 expo at Faridabad during 17-21 January, 2024 **(Figure 71)**. More than 500 students visited the ARIES stall in the expo.

Figure 69. Outreach activities at Tamilnadu Science and Technology Centre, Chennai following the Aditya-L1 launch.

Figure 70. School students thronging the ARIES stall at the *Gatisheel Jammu Aur Kashmir* exhibition at Jammu.

Figure 71. ARIES stall within the DST pavilion at the IISF 2024 expo at Faridabad.

Outreach through Digital, Print and Social Media

Many science stories were shared with DST Media Cell based on recent research works from ARIES. Press releases were shared with local media on celestial events of public interest and important events at ARIES **(Figure 72)**. Special emphasis was given on stories and press releases in Hindi. ARIES social media handles were also used actively for wider outreach through online mode **(Figure 73)**.

इंडिया इंटरनेशनल साइंस फेस्टिवल पर जनसंपर्क कार्यक्रम का किया आयोजन

प्रधान टाइम्स ब्यूरो

नैनीताल। आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज) विज्ञान एवं प्रौद्योगिकी विभाग, भारत सरकार के अंतर्गत एक स्वायत्त संस्थान है। एरीज ने मनोरा पीक, नैनीताल स्थित अपने मुख्य परिसर में इंडिया इंटरनेशनल साइंस फेस्टिवल (IISF) 2023 पर एक जनसंपर्क कार्यक्रम का आयोजन किया।

इंडिया इंटरनेशनल साइंस फेस्टिवल विज्ञान भारती, जो कि स्वदेशी भावना के साथ देश के वैज्ञानिकों द्वारा संचालित एक विज्ञान आंदोलन है, के साथ विज्ञान एवं प्रौद्योगिकी मंत्रालय, पृथ्वी विज्ञान मंत्रालय, अंतरिक्ष विज्ञान विभाग और परमाणु ऊर्जा विभाग के बीच एक सहयोगात्मक प्रयास है। ताप्ती वैली इंटरनेशनल स्कूल, सूरत, गुजरात से कक्षा 10-12 के 51 छात्रों और 4 शिक्षकों के एक समूह ने एरीज का दौरा किया और इस जनसंपर्क कार्यक्रम में भाग लिया। सत्र का उद्घाटन वरिष्ठ खगोलशास्त्री और एरीज में खगोल विज्ञान प्रभाग के अध्यक्ष डॉ. बृजेश कुमार ने किया।

दी। एरीज में जनसंपर्क गतिविधियों के प्रभारी डॉ. वीरेंद्र यादव द्वारा छात्रों को विभिन्न खगोलीय पिंडों, दूरबीनों के मूल सिद्धांत और 104 सेमी संपूर्णानंद टेलीस्कोप का दौरा कराया गया। इसके साथ ही एरीज की जनसंपर्क टीम ने छात्रों के लिए सौर धब्बों का प्रदर्शन, प्रकाश प्रदूषण और वित प्राणियों के साथ-साथ खगोल विज्ञान पर इसके प्रभाव पर एक तारामंडल शो, एरीज पर एक वृत्तचित्र की स्क्रीनिंग और सूर्यास्त के बाद दूरबीन के माध्यम से आकाश दर्शन की भी व्यवस्था की। छात्र बहुत जिज्ञासु थे और उन्होंने वैज्ञानिकों और जनसंपर्क टीम के साथ चर्चा में सक्रिय रूप से भाग लिया।

Figure 72. News clipping from local print media describing activities at ARIES.

Figure 73. Screenshots from ARIES's X (formerly Twitter) and Facebook feed.

Other Outreach Activities

The outreach team participated in a nationwide study initiated by IAU-Office of Astronomy Education (OAE) Center - India and conducted a survey on Astronomy education in the nearby schools in Nainital representing Uttarakhand. ARIES members actively helped conduct the outreach activities organised by the Astronomical Society of India's Public Outreach & Education Committee (ASI-POEC) around the ASI Annual Meeting at IISc Bangalore during 31 January - 4 February, 2024. Thematic outreach programmes were also conducted. On 4 September 2023 as part of the Hindi Maah, a science story session on *Saurmandal Ki Sair* topic by Bal Sahitya Puraskar 2021 awardee Shri. Devendra Mewari was organised for Hindi medium school students **(Figure 74)**. During the World Space Week (4-10 October, 2023) in which more than 100 NCC cadets from Karnataka, Goa and Uttarakhand visited ARIES. Stargazing sessions were conducted for hundreds of NCC cadets at a nearby NCC camp. On the occasion of Geminid Meteor Shower a special overnight meteor watching session on the night of 13-14 December, 2023 was held at ARIES for the general public. ARIES conducted a two day outreach programme on astronomy at Swami Shukdevanand College, Shahjahanpur during 15-16 March, 2024 **(Figure 75)**. A large number of schools, including many from outside Uttarakhand, visited ARIES for educational visits. Many general visitors, including tourists from across India, visited the two science centres for day as well as night visits.

Figure 74. Bal Sahitya Puraskar 2021 awardee Shri. Devendra Mewari taking school students on *Saurmandal Ki Sair* (Journey of Solar System) in Hindi.

Figure 75. Stargazing session at Swami Shukdevanand College, Shahjahanpur, UP.

Other Scientific Activities

ARIES organised eight conferences/workshops/schools during this year. Three of these were a part of the Azadi Ka Amrit Mahotsav commemoration activities at ARIES.

ARIES Training School in Observational Astronomy (ATSOA) during 17-28 April, 2023

Every year ARIES conducts ATSOA, a training programme for post-graduate students introducing them to various topics in astronomy. The programme includes pedagogical talks in astronomy and hands-on/demonstration sessions on various data processing techniques such as photometry, spectroscopy, polarimetry, and machine learning every day. 44 students from universities and institutes across India participated in ATSOA-2023 **(Figure 76)**. Through this capacity building programme ARIES aims to develop a talent pool in the country with expertise in astronomical data-analysis and encourage them for potential careers in astronomy.

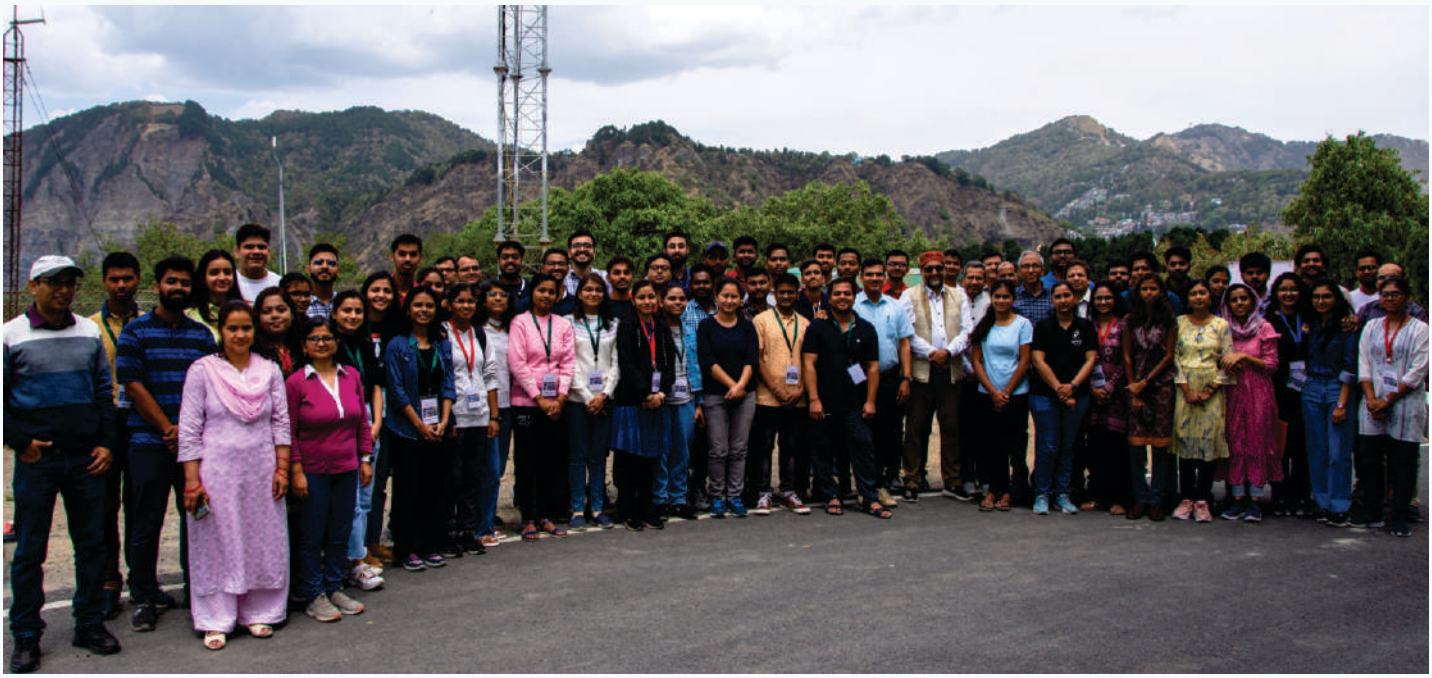

Figure 76. Group photo of ATSOA-2023 participants with ARIES faculty and research scholars.

ARIES In-house meeting - 2023 during 23-24 May 2023

A 2 day in-house meeting was organised at ARIES to review the scientific and engineering activities and the status of various facilities in the institute during the previous year. The meeting included talks by group coordinators and posters by senior students. The discussions will be useful to pave the future course of the institute.

Aditya-L1 Workshops

During 2023-24, three AL1SC workshops were conducted. The 4th AL1SC workshop was conducted at ARIES during 28 June - 7 July, 2023. The 5th AL1SC workshop was conducted at IIT Kanpur during 29 September - 1 October, 2023. The 6th AL1SC workshop was hosted by JECRC University, Jaipur during 6-8 February, 2024. Cumulatively over 130 MSc/ Int. MSc/ Int. PhD/ BTech/ MTech students were trained during these workshops **(Figure 77)**.

Figure 77. Group photos of the 4th, 5th and 6th AL1SC workshop participants.

Advances in Relativistic Astrophysics (AReA) conference during 2-4 November, 2023

Relativistic astrophysics deals with the physics around compact objects like black holes, neutron stars and phenomena like astrophysical jets. Landmark missions such as AstroSat and XpoSat along with India's involvement in megaprojects such as LIGO-India and Square Kilometre Array (SKA) have bolstered the Indian relativistic astrophysics community. In view of this growing field, ARIES organised AReA, a national conference on relativistic astrophysics. 40 researchers presented their work, including 15 experts in the field and the rest being research scholars and post-docs **(Figure 78)**. A special lecture was delivered by Prof. Narayan Banerjee, IISER Kolkata, to commemorate the birth centenary of Prof. Amal K. Raychaudhuri.

Figure 78. Group photo of AReA participants.

Beyond Aditya-L1: Exploring the future of Indian solar physics from space during 7-9 November, 2023

The launch of Aditya-L1 mission was a remarkable endeavour that ignited immense enthusiasm within the Indian solar physics community. There was a growing consensus among experts that it was the right time to lay the groundwork for forthcoming solar space expeditions. This also aligned seamlessly with the visionary goals outlined in the Astronomical Society of India's (ASI) vision document, a meticulously crafted roadmap by the broad astronomy community. Hence, the Beyond Aditya-L1 meeting was organised to bring solar physicists together to discuss possible future space missions to study the Sun **(Figure 79)**. The meeting consisted of talks and group discussions and provided a platform for identifying and nurturing potential focal areas in solar physics.

Figure 79. Group photo of Beyond Aditya-L1 meeting participants.

Winter School on Concepts in Solar Physics during 19-23 December, 2023

ARIES and NIT Delhi jointly organised this 5-day school at the NIT with financial assistance from SERB. The aim of the school was to teach basic concepts of solar physics and introduce some advanced topics primarily to young students working in solar physics. Experts from various national and international universities and institutes gave lectures covering a wide variety of topics such as solar activity, dynamo models, spectropolarimetric inversions, MHD waves and instabilities, solar atmosphere, magnetic reconnection, Coronal Mass Ejections (CMEs), solar wind, the Sun-Earth connection. Hands-on sessions focused on teaching specific analysis techniques/tools relevant for handling multi-wavelength data from various solar missions. Total 56 (39 PhD and 17 MSc) students participated in the school **(Figure 80)**. During the school ARIES signed an MoU with NIT Delhi **(Figure 81)** to initiate joint academic courses and facilitate exchange visits between the two institutions.

Figure 80. Group photo of the participants of the Winter School on Concepts in Solar Physics.

Figure 81. MoU signing between ARIES and NIT Delhi.

Talk/Poster presentation by ARIES Members

Jagdish C. Joshi

Cosmic rays/gamma rays from GRBs, 11-15 Dec, 2023, International Conference on High Energy Particle and Astroparticle Physics (ICHEPAP2023) at Saha Institute of the Nuclear Physics in Kolkata. *(Partcipant)*

Probing Cosmic Ray Sources through Multimessenger Modelling: Pevatrons in Our Galaxy, 31 Jan- 4 Feb, 2024, 42nd Meeting of Astronomical Society of India. *(talk)*

Probing Galactic Sources through Multimessenger Modelling: Plausible Pevatrons in Our Galaxy, 2 Aug, 2023, Saha Institute of Nuclear Physics at Kolkata. *(invited talk)*

Kuntal Misra

26 - 30 June, 2023, Kavli Summer Program Conference-The lives, deaths and afterlives of interacting stars (*virtual*). (*participant*)

10 - 14 July, 2023, The 8th International Conference on Women in Physics (ICWIP) (virtual). (*panellist*)

28 August - 01 September, 2023, SNeX – Supernova Explosions conference, Technion, Israel (virtual). (*participant*)

2 - 4 November, 2023, Advances in Relativistic Astrophysics (AReA), ARIES, Nainital. *(SOC and LOC member)*

6 - 10 November, 2023, SuperVirtual 2023- A virtual conference on supernovae and transients (virtual). *(participant)*

29 Nov-01 Dec, 2023, Shaw-IAU Workshop on Astronomy for Education (virtual). *(participant)*

Final stages of stars – energetic cosmic explosions, 17 - 28 April, 2023, ARIES Training School in Observational Astronomy (ATSOA), ARIES, Nainital. *(invited talk)*

Multi-messenger Astronomy, 27 - 28 October, 2023, Discussion meeting on LIGO Science Workshop, ICTS, Bengaluru, India. *(invited talk)*

The optical counterparts of Gamma Ray Bursts, 15 - 16 January, 2024, Multi-messenger meeting at IIT Indore, Indore, India. *(invited talk)*

The optical counterparts of astrophysical transients – success and shortcomings, 31 January to 4 February, 2024, Planning a more robust followup of transient astronomical sources from India workshop during the 42nd meeting of the Astronomical Society of India (ASI 2024), Bengaluru, India. *(invited talk)*

The 4.0m International Liquid Mirror Telescope, 16 - 19 October, 2023, BRICS Astronomy Working Group Meeting (BAWG 2023). *(Contributory)*

Unveiling the progenitors of core-collapse supernovae using optical observations, 31 January to 4 February, 2024, The 42nd meeting of the Astronomical Society of India (ASI 2024), India. *(Poster)*

Time Domain Astronomy, 23-24 May, 2023, ARIES In-House Meeting (AIM). *(invited talk)*

Narendra Singh

3 April, 2023, Selection committee, IIG Mumbai. *(Expert)*

An introduction to Atmospheric Physics, 17 - 28 April, 2023, ARIES Training School in Observational Astronomy (ATSOA), ARIES, Nainital. *(invited talk)*

Research and Academic Activities of Atmospheric Science Division, 23-24 May, 2023, ARIES In-House Meeting (AIM). *(talk)*

Climate Change and its Impacts on the Himalayan Ecosystem, 27-28 April, 2023, National Conference on "India's G20 Presidency & Green-growth Strategies for Sustaining Himalayan Societies under Changing Climate: Policy, Pathway & Tools" by GBP-NIHE, Almora. *(invited talk)*

28 Nov – 01 Dec, 2023, 6th World Congress on Disaster Management, Graphic Era Dehradun. *(participant)*

December 11-15, 2023, Americal Geophysical Union (AGU) Fall meeting 2023 (Online). *(participant)*

India International Science Festival: Objective and Major Programs, 10 Jan, 2024, IISF-2023 Curtain raiser: ARIES auditorium , Nainital. *(Talk-public outreach)*

Posters and/or oral presentation evaluation: under Young Scientiost Conclave,* 17-20 Jan, 2024, India International Science Festival (IISF-2023), DBT-THSTI & RCB, Faridabad, Haryana. *(Jury Member)*

Measurement Techniques for Earth's Atmosphere, 20-22 Feb, 2024, Physics Teacher's workshop, Department of Physics, HNB garhwal Central University Srinagar. *(invited talk)*

Basics of the earth's atmosphere and measurement tools, 26 Feb -1 Mar, 2024, Central University ,Bagla, Rahya-Suchani, Jammu , J& K. *(invited talk)*

Air pollution, Observations and Climate Change in the Himalayas, 27 Feb -1 Mar, 2024, Central University , Bagla, Rahya-Suchani,Jammu , J& K. *(invited talk)*

6–8 March, 2024, NationalConference, Trending Biotechnological Interventions to Address & Combat Himalayan Biodiversity Challenges" Uttarakhand Council forBiotechnology, Regional Center, Patwadangar, Nainital. *(Expert)*

Air pollution and PM2.5 measurements in the Himalayan region, 18 - 22 March, 2024, International Workshop and Winter School on Hands -on -Training on Instrumentation and Analytical Techniques for Atmospheric Aerosol Measurements, Source Apportionment and Prediction over Bharat. *(invited talk)*

Neelam Pawar

Multi-wavelength Studies of Young Star Clusters and HII regions, 8-11 January, 2024, Star Formation Studies in India at S. N. Bose National Centre for Basic Sciences, Kolkata . *(talk)*

S. Krishna Prasad

Sloshing oscillations in hot coronal loops, 3 - 5 April, 2023, Udaipur Solar Physics Workshop. *(Invited talk)*

Introduction to the Sun and its structure, 29 Sep – 1 Oct, 2023, 5th Aditya-L1 Support Cell Workshop. *(Invited talk)*

Coronal signatures of transition region downflows within a Sunspot, 31 Jan – 4 Feb, 2024, 42nd Astronomical Society of India (ASI) meeting. *(Contributory)*

Introduction to the Solar atmosphere, 6 - 8 Feb, 2024, 6th Aditya-L1 Support Cell Workshop. *(Invited talk)*

Santosh Joshi

Photometric and spectroscopic exploration of A-F type stars, 5 December, 2023, Multi-Messenger Astronomy in the BRICS Framework Workshop, hosted by SAO, Russia (virtual). *(Invited talk)*

A glimpse of the observational facilities in India and synergies with Asteroseismology, 01 March, 2024, Department of Physics college of Science and Technology, University of Rawanda (Virtual). *(Invited talk)*

Indian astronomical observing facilities:Prospects for Asteroseismology, 04 March, 2024, National Center for space research and development Agency, Nigeria. *(Invited talk)*

Introduction to Asteroseismology, 17-28 April, 2023, ATSOA, AIRES-Nainital. *(Invited talk)*

Saurabh Sharma

Role of filaments in the formation of stars in the NGC 2316 star cluster, 8-11 January, 2024, Star Formation Studies in India at S. N. Bose National Centre for Basic Sciences, Kolkata . *(talk)*

Star formation in NGC 2316 Star Cluster, 31 Jan - 4 Feb, 2024, ASI 2024 meeting at IISc Bangalore. *(poster)*

Virendra Yadav

Taking Astronomy to General Public, 17-28 April, 2023, ARIES Training School in Observational Astronomy (ATSOA), ARIES, Nainital. *(invited talk)*

Why Should We Study Astronomy?, 29 November, 2023, Thakur College of Science and Commerce, Mumbai. *(invited talk)*

Why Should We Study Astronomy?, 29 November, 2023, Royal College of Arts, Science and Commerce, Thane. *(invited talk)*

Guardians of Planets: Magnetic Fields, 23 December, 2023, IAPT Lecture Series on Planetary Science, Wilson College, Mumbai. *(invited talk)*

Yogesh Chandra Joshi

3 - 5 April, 2023, Recent Trends in the study of Compact Objects (RETCO-V): Theory and Observation at Kodaikanal Observatory. *(Partcipant)*

Multi-band and Multi-instrument study of the transiting exoplanets, 17-19 Sep, 2023, Strange New Worlds: The

Exploration of Exoplanets at IISER Pune. *(Invited talk)*

5-7 Sep, 2023, The Milky Way Revealed by Gaia: The Next Frontier at University of Barcilona, Spain (virtual). *(Partcipant)*

10 Oct, 2023, BINA/BIPASS meeting at Royal Observatory Belgium (virtual). *(Partcipant)*

11-13 Sep, 2023, Revealed by Gaia: the central halo of the Milky Way at IoA Camridge, UK (virtual). *(Partcipant)*

Understanding the Exoplanets, 17-28 April 2023, ARIES Training School in Observational Astronomy (ATSOA), ARIES, Nainital. *(invited talk)*

Discussion on future exoplanet missions, 12 Dec, 2023, Indian exoplanets community involvement in the upcoming NASA Havitable World Observatory, NASA, US (virtual). *(invited talk)*

Understanding the Exoplanets, 20 Nov, 2023, Science fest at G I C Hawalbagh. *(invited talk)*

Probing the nature of Luminous blue variables, 5 Jan, 2024, Collaborative visit to NIT Rourkela under ongoing SERB project. *(invited talk)*

Photometric, Kinematic, and Variability Study of Open Clusters, 8-11 Jan, 2024, Star formation conference at S N Bose, Kolkata. . *(invited talk)*

Rajbhasha Hindi Division

The use of Hindi at ARIES has increased substantially in past years. The objective of Rajbhasha division is that Hindi be used in all office work to the maximum extent possible. This will be in keeping with the spirit of the Constitution. Needless to say that doing official work in the peoples' language will speed-up development and bring transparency in administration.

In the present era, it is essential for development of any language to associate it with Information Technology. With the expansion of technology and its ever-increasing access to the people, it is now becoming easier to use more and more Hindi in scientific and technical subjects in almost all division of ARIES. We are working on necessary steps to get Scientific and Technical literature prepared in Hindi and made available for the use of public. We used all the tools developed by Rajbhasha Vibhag and other institutes for typing, translation etc.

The Department of Official Language on the occasion of Azadi ka Amrit Mahotsav of the country's independence organized Second All India Official Language Conference on 14-15, September 2023 at Pune (Maharashtra) very successfully under the leadership of Hon'ble Home and Cooperation Minister. Members from ARIES also participated in this event. ARIES is a member of Town Official Language Implementation Committee (TOLIC) Haldwani & received the TOLIC Shield and first prize in November 2023 **(Figure 82)**. Total 43 offices are registered under TOLIC Haldwani. The institute is confident that the official language team and all other employee will get inspiration and encouragement from such events.

ARIES members are regularly participating in the activities carried out by TOLIC. At present, the coordinator of TOLIC, Haldwani is Regional Office, Bank of Baroda, Haldwani.

Our main focus is to use Hindi in all the official work. Quarterly and annual reports were submitted to ministry in timely manner. All the government orders and annual programme released by Rajbhasha vibhag are being followed properly at ARIES.

Figure 82. Prof. Dipankar Banerjee, Director and Mr. Mohit Joshi, Head, Hindi Advisory Committee receiving the First prize and trophy of TOLIC for ARIES.

Staff Welfare Measure

Implementation of Right to Information (RTI) Act: CPIO and ACPIO are designated at ARIES and handling all the activities of RTI Cell efficiently. The objectives of the RTI Act is to empower citizens to question the government. The act promotes transparency and accountability in the working of the government organizations. Right to Information Act 2005 mandates timely response to citizen requests for government information.

At ARIES, the Right to information is governed by Central Information Commission (CIC). A digital portal has been set up by government, which acts as a gateway to the citizens for quick search of information on the details of first Appellate Authorities, PIOs etc. amongst others, besides access to RTI related information disclosures published on the web by various Public Authorities under the government of India. At ARIES, RTI applications are being received by online RTI portal and offline as well. We have received total 88 RTI requests during 2023-24 and all were disposed of.

The Act makes it obligatory for institute to make suo motu disclosure in respect of the particulars of its organisation, functions, duties and other matters, as provided in section 3 of the Act. This information is available at ARIES website, according to sub-section (3) of section 3 and can be accessed easily. The requirements of the Section 3 are met and maximum information in respect of the institute is available on institute's website. It helps CPIO in two ways:

First, the number of applications under the Act are reduced and secondly, it facilitate CPIO's work as most of the information is available at one place.

The suo motu disclosures are available at the website of ARIES and updated in timely manner. Self-appraisal of RTI disclosures has been done and third party audit by nominated authorities is under process.

At ARIES, we are following the guidelines of RTI Act properly, so that the citizen could be benefited. Quarterly and annual reports are being submitted to ministry in timely manner. All the government orders and annual programme released by competent authorities are being followed properly at ARIES.

Medical Facility: The institute has its medical reimbursement system through which bills on expenses of both indoor and outdoor treatment for all employees and their dependent family members are reimbursed as per CGHS rates. ARIES has empanelled multiple hospitals in Haldwani, Nainital on cashless basis through which bills on expenses are reimbursed as per CGHS rates. Two doctor are engaged by ARIES who visit the institute on a regular basis. The dispensary is equipped with generic medicines and commonly used medical instruments.

Awareness programmes at ARIES

Prevention of Sexual Harassment of Women at Work Place: ARIES is committed to provide a safe and dignified working environment to all its employees. In this regard, ARIES have constituted the *Internal Complaints Committee against Sexual Harassment* in accordance with the "The Sexual Harassment of Women at Workplace (Prevention, Prohibition and Redressal) Act, 2013" of the Government of India for redressal of complaint made by any employee of ARIES regarding sexual harassment by a co-employee. No complaints have been received during the year. ARIES was commemorated the week 4-9 December 2023 as "Sexual Harassment at Workplace Prevention Week" **(Figure 83)**.

Figure 83. Awareness programme on Sexual Harassment Act.

Cleanliness Drives: Two cleanliness drives were conducted in the form of Swachhata Pakhwara and Special campaign 2.0 for Swachhata. In these ARIES made dedicated efforts for a green and pollution free campus. Waste management steps were implemented and several idle composting pits were rejuvenated. For optimum utilisation of office space decluttering exercise was carried out and inefficiently used areas were gradually repurposed to create new office space.

Blood Donation Camp: The 10th blood donation drive was held at ARIES's Manora Peak campus on 5 October, 2023. 18 members, including many first time donors, came forward for this noble cause **(Figure 84)**.

Figure 84. Blood donation drive at ARIES.

Group Insurance: A Group Insurance Scheme for the employees of the institute is operating in association with the Life Insurance Corporation of India. All the regular employees of the institute are members of the scheme.

Reservation Policy: The Institute is following post based rosters for affecting the prescribed percentage of reservations to SC/ST/OBC in all its new recruitments as per Government of India rules in this regard.

Canteen Facility: The institute has a canteen run by ARIES on no loss no benefit basis. In the canteen meals, snacks and beverages are prepared in hygienic condition and are served to employees, students and guests at subsidized rates.

Apart from this, the institute has a departmental store which serves employees and their family members residing in the campus.

Recreational Facilities: The institute has set up recreational facilities at the campus for the use of staff and their family members and the Ph.D. students/PDFs. The club house hosts a TT table and other indoor games. There are two full fledged badminton courts (outdoor and indoor) and a gymnasium in the campus. The welfare committee organises annual sports and cultural events meet on the occasion of Gandhi Jayanti **(Figure 85 and 86)**.

Figure 85. A Volleyball match in progress at ARIES campus .

Figure 86. PhD. students playing badminton during annual sports meet at ARIES.

Members of ARIES

Academic (23)

Prof. Dipankar Banerjee *(Director)*

Alok C. Gupta
Brijesh Kumar
Jagdish Chandra Joshi
Kuntal Misra
Neelam Panwar
Shashi Bhushan Pandey
Suvendu Rakshit
Virendra Yadav
Brajesh Kumar *(Project Scientist) (till 25-08-23)*
Haritma Gaur *(Inspire Faculty Fellow)*
Jeewan C. Pandey
Manish Naja
Ramakant Singh Yadav
Saurabh
Umesh C. Dumka
Yogesh C. Joshi
Indranil Chattopadhyay
Krishna P. Sayamanthula
Narendra Singh
Santosh Joshi
Sneh Lata
Vaibhav Pant

Engineering (12)

Ashish Kumar
Jayshreekar Pant
Nandish Nanjappa
Shobhit Yadava
B. Krishna Reddy
Mohit K. Joshi
Sanjit Sahu
Tarun Bangia
Chandra Prakash
Mukeshkumar B. Jaiswar
Samaresh Bhattacharjee
Tripurari S. Kumar

Administrative and Support (14)

Rajneesh Mishra *(Registrar) (from 12-10-23)*
Abhishek Kumar Sharma
Hansa Karki
Manjay Yadav
Rajendra Prasad Joshi *(till 30-09-23)*
Bharat Singh *(Asstt. Registrar)*
Amar Singh Meena
Himanshu Vidhyarthi
Praveen Solanki
Ram Dayal Bhatt
Basant Ballabh Bhatt
Mahesh Chandra Pande *(till 15-12-23)*
Rajeev Kumar Joshi
Virendra Kumar Singh

Scientific and Technical (28)

Abhijit Misra
Arjun Singh
C. Arjuna Reddy
Hemant Kumar
Kanhaiya Prasad
Manoj Kumar Mahto
Pavan Tiwari
Rajdeep Singh
Sanjay Kumar Singh
Uday Singh
Anant Ram Shukla
Ashok Kumar Singh
Darwan Singh Negi
Imandi Sai Bhaskar
Kanti Ram Maithani
Naveen Chandra Arya
Pooja Joshi
Rajendra Prasad
Shyam Lal
Anil Kumar Joshi *(till 30-06-23)*
Babu Ram
Harish Chandra Tewari
Javed Alam
Lalit Mohan Dalakoti
Nitin Pal
Pradip Chakarborty
Ravindra Kumar Yadav
Srikant Yadav

MTS/Laboratory Assistant/Attendants (6)

Amit Yadav
Pawan Joshi
Ashok *(till 30-04-23)*
Rakesh Kumar
Mohit Kumar
Suresh Chandra Arya

Post Doctoral Fellows/Research Associate (18)

Abhijit Roy
Athira Unni
Deepak *(till 27-03-24)*
Krishna Mohana
Amar Deo Chandra
Balveer Singh
Divya Pandey
Neha Sharma
Arpan K Mitra
Bharati Paul
Kshitiz Kr. Mallick *(till 31-01-24)*
Partha Pratim Goswami

Raghubar Singh *(till 21-04-23)*
Sharmila Rani
Samrat Ghosh
Shishir Kumar Singh
Satabdwa Majumdar *(till 10-10-23)*
Varun *(till 17-04-23)*

Research Scholars (63)

Aayushi Verma
Akhilesh Ray
Ambika Saxena
Archana Kumari
Ashutosh Tomar
Bhavya
Dhruv Jain
Dimple *(till 04-11-23)*
Jincen Jose
Khusboo Sharma
Mamta
Mrinmoy Sarkar
Neel Vadodaria *(till 12-07-23)*
Prajjwal Singh Rawat *(till 0xx-xx-xx)*
Priyesh Kumar Tripathi
Rahul Gupta *(till 02-11-23)*
Sanjit Debnath
Srinivas M. Rao
Surath Chandra Ghosh
Upasna Baweja
Vikas Rawat
Aditya Jaiswal *(till xx-xx-xx)*
Alaxender Panchal *(till 18-10-23)*
Amit Kumar Ror
Arpit Shrivastav
Athul Dileep
Debalina Kar
Divyanshu Janghel
Gurpreet Singh
Jyoti
Mahadev A V
Manojit Chakraborty
Mukesh Kumar
Nikita Rawat *(till 02-11-23)*
Prakhar Singh
Rajkishore Joshi *(till 02-11-23)*
Rohan Bose
Shivangi Pandey
Srinjana Routh
Tarak Chand
Vaibhav Pauchalee *(till 31-05-23)*
Vikrant Tomar
Akanksha Rajput *(till 29-02-24)*
Amar Aryan *(till 05-11-23)*
Anshika Gupta
Arvind Kumar Dattatrey
Bablu Mandal
Devanand PU
Dibya Kirti Mishra
Jaydeep Singh *(till xx-xx-xx)*
Karan Dogra
Mahendra C. Rajwar
Monalisa Dubey
Naveen Dukiya
Nitin Vashishtha
Pritam Das
Rahul
Rishi C.
Shubham Kishore
Sunil Kumar
Tushar Tripathi
Vibhore Negi *(till 02-11-23)*
Vinit Dhiman *(till 25-06-23)*

Integrated M.Tech-Ph.D. (Tech.) (06)

Arjun Dawn
Purvi Udhwani *(till 03-02-24)*
Kartik Ghanshyam Gokhe
Sarvesh Kumar Yadav
Kumar Pranshu
Tushar Gajanan Ubarhande

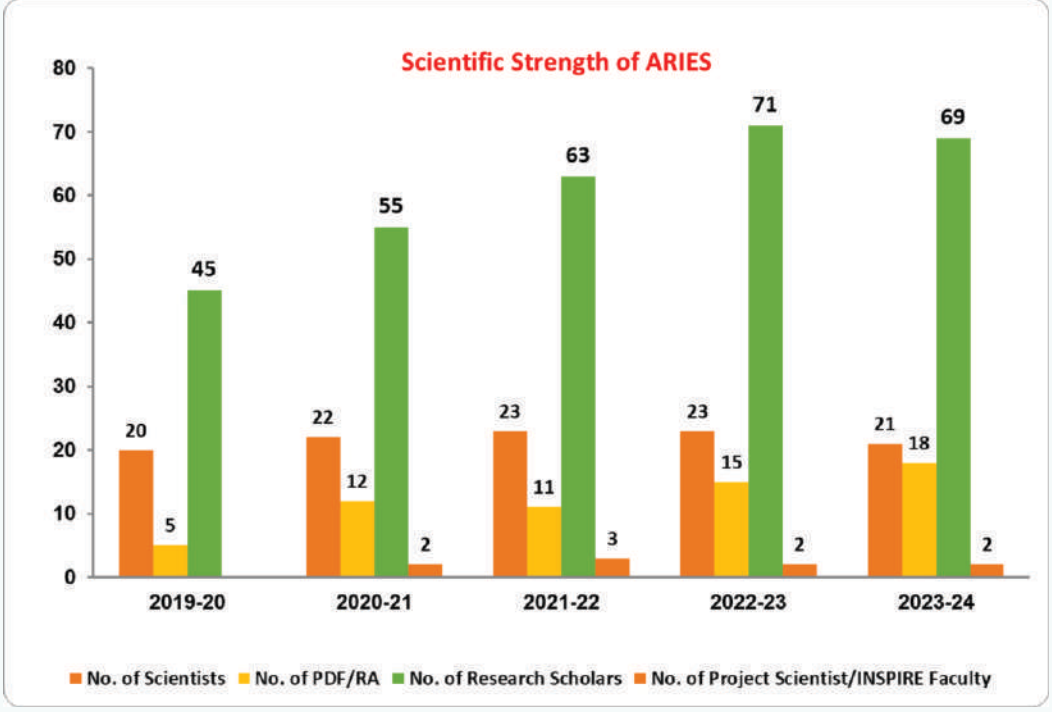

Figure 86. Scientific strength of ARIES during the last five years.

Research Associates

Dr. Amar Deo Chandra

Dr. Arpan K. Mitra

Dr. Athira Unni

Mr. Balveer Singh

Dr. Bharti Paul

Dr. Divya Pandey

Mr. Partha Pratim Goswami

Dr. Samrat Ghosh

Dr. Shishir Kumar Singh

Dr. Sarmila Rani

Research Scholars

Mr. Akhilesh Ray

Ms. Archana Kumari

Ms. Debalina Kar

Mr. Dhruv Jain

Mr. Divyanshu Janghel

Mr. Mahadev A. V.

Mr. Manojit Chakraborty

Mr. Mukesh Kumar

Mr. Prakhar Singh

Mr. Sunil Kumar

Mr. Surath Chandra Ghosh

Integrated M. Tech-Ph.D. Students

Mr. Kartik G. Gokhe

Mr. Tushar G. Ubarhande

Abbreviations

2MASS	Two Micron All-Sky Survey
AC	Academic Committee
ADFOSC	ARIES Devasthal Faint Object Spectrograph & Camera
AGN	Active Galactic Nuclei
AGU	Auto Guider Unit
AL1SC	*Aditya-L1* Support Cell
AOS	Active Optical System
ARISS	Adapter Rotator Instrument Support Structure
ASI	Astronomical Society of India
ASPOP	ARIES Science Popularisation and Public Outreach Programme
ASTRAD	ARIES Stratosphere Troposphere Radar
ATM	Atmosphere
ATSOA	ARIES Training School in Observational Astronomy
AWS	Amazon Web Services
BAL	Broad Absorption Line
BAT	Burst alert telescope
BHI	Beam Horizontal Irradiance
BLSy1	Broad Line Seyfert1
CAD	Computer-Aided Design
CCD	Charged Coupled Device
CCTV	Closed Circuit Television Camera
CGHS	Central Government Health Scheme
CME	Coronal Mass Ejection
CMM	Coordinate Measuring Machine
CNC	Computer Numerical Control
CO	Carbon mono Oxide
CSP	Concentrated Solar Power
DDT	Director's Discretionary Time
DFOT	Devasthal Fast Optical Telescope
DOMU	DOT Operation, Maintenance and Upgradation

DOT	Devasthal Optical Telescope
DTAC	DOT Time Allotment Committee
DST	Department of Science and Technology
eBC	equivalent Black Carbon
EC	Elemental Carbon
ENSO	El Niño–Southern Oscillation
ESC	Extended Solar Cycle
ESD	Electrostatic discharge
EUV	Extreme Ultraviolet
FEA	Finite Element Analysis
FOV	Field Of View
FSRQ	Flat Spectrum Radio Quasar
FWHM	Full Width at Half Maximum
GATE	Graduate Aptitude Test in Engineering
GHI	Global Horizontal Irradiance
GNSS	Global navigation satellite system
GPS	Global Positioning System
GRB	Gamma Ray Burst
GUI	Graphical User Interface
HCT	Himalayan Chandra Telescope
HPA	High Power Amplifier
HPC	High Performance Computer
HRS	High Resolution Spectrograph
HST	Hubble Space Telescope
ILMT	International Liquid Mirror Telescope
INOV	Intra Night Optical Variability
ICT	Instrument Change Time
IR	Infrared
IRAS	Infrared Astronomical Satellite
ISM	Interstellar Medium
IVT	Instrument Verification Time

JEST	Joint Entrance Screening Test
JRF	Junior Research Fellow
JTAC	Joint Time Allocation Committee
KRC	Knowledge Resource Center
LAT	Large Area Telescope
LS	Lower Stratosphere
MAC	Mass Absorption Cross-section
TMT-MAC	TMT-Management Advisory Committee
MESA	Modules for Experiments in Stellar Astrophysics
MHD	Magnetohydrodynamic
MoU	Memorandum of Association
NE	Northeast
NET	National Eligibility Test
NGC	New General Catalog
NIC	National Informatics Centre
NKRC	National Knowledge Resource Consortium
NLSy1	Narrow Line Seyfert1
NSSL	Near-Surface Shear Layer
OPAC	Online Public Access Catalogue
PCB	Printed Circuit Board
PDF	Post Doctoral Fellow
PLC	Programmable Logic Controller
PMB	Project Management Board
PMS	Pre-Main-Sequence
PSF	Point Spread Function
PSU	Power Supply Unit
PWV	Precipitable Water Vapour
QPE	Quasi-Periodic X-ray Eruptions
QPO	Quasi-Periodic Oscillation
RWB	Redder-When-Brighter
sCMOSscientific	Complementary Metal Oxide Semiconductor

SCADA	Supervisory Control and Data Acquisition
SEA	Superposed Epoch Analysis
SFC	Surface
SRF	Senior Research Fellow
SNe	Supernovae
SNEC	Supernova Explosion Code
ST	Sampurnanand Telescope
TANSPEC	TIFR-ARIES Near Infrared Spectrometer
TCS	Telescope Control System
TESS	Transiting Exoplanet Survey Satellite
TIFR	Tata Institute of Fundamental Research
TIRCAM2	TIFR Near Infrared Imaging Camera – II
TMT	Telescope Maintenance Time
TOA	Top Of the Atmosphere
TRM	Transmit Receive Module
UCoMP	Upgraded Coronal Multi-channel Polarimeter
UPS	Uninterrupted Power Supply
UT	Upper Troposphere
UV	Ultraviolet
VELC	Visible Emission Line Coronagraph
VSP	Visiting Student Programme
WFOS	Wide-Field Optical Spectrometer
WFS	Wave Front Sensor
WISE	Wide-field Infrared Survey Explorer
WR	Wolf-Rayet
XD	Cross Dispersed
XRT	X-ray Telescope
YSO	Young Stellar Object
ZAMS	Zero Age Main Sequence

Audit Statements of Account

2023-2024

R S KAFALTIYA & ASSOCIATES

Chartered Accountants

FRN: 024191C

INDEPENDENT AUDITOR'S REPORT
FINANCIAL YEAR – 2023-2024

UDIN:24411796BKGSDI2342
Dated: September 9, 2024

To,
THE REGISTRAR,
ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES),
UNDER THE DEPARTMENT OF SCIENCE & TECHNOLOGY (DST),
GOVERNMENT OF INDIA, MANORA PEAK,
NAINITAL – 263139
UTTARAKHAND

Report on the Audit of the Financial Statements

(1) Opinion:

We have audited the accompanying Financial Statements of **"ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES), NAINITAL, ("The Institute") (PAN: AAAAA8701B),** which comprise the Balance sheet as at March 31, 2024, the statement of Income & Expenditure and the Statement of Receipt & Payment for the year then ended, and notes to the financial statements, including a summary of significant accounting policies.

In our opinion, and to the best of our information and according to the explanations given to us the accompanying financial statements, give the information required by the applicable Indian laws and regulations to the Institute in the manner so required and give a true and fair view in conformity with the accounting principles generally accepted in India, of the financial position of the Institute as at March 31, 2024 and its financial performances for the year then ended.

(2) Basis for Opinion:

We conducted our audit in accordance with the Standards on Auditing (SAs) issued by ICAI. Our responsibilities under those Standards are further described in the Auditor's Responsibilities for the Audit of the Financial Statements section of our report. We are independent of the Institute in accordance with the code of ethics issued by the Institute of Chartered Accountants of India (ICAI) together with the ethical requirements that are relevant to our audit of the financial statements and we have fulfilled our other ethical responsibilities in accordance with these requirements and the code of ethics. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion on the financial statements.

(3) Key Audit Matters:

Key Audit Matters are those matters that, in our professional judgment, were of most significance in our audit of the financial statements of the Institute for the year ended March 31, 2024. These matters were addressed in the context of our audit of the financial statements as a whole, and informing our opinion thereon, and we do not provide a separate opinion on these matters

R S KAFALTIYA & ASSOCIATES Chartered Accountants FRN:024191C

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www.rskafaltiya.com

We have determined the matters described below to be the Key Audit Matters to be communicated in our report. We have fulfilled the responsibilities described in "Auditor's Responsibilities for the Audit of the Financial Statements" section of our report, including in relation to these matters

Accordingly, our audit included the performance of procedures designed to respond to our assessment of the risks of material misstatements of the financial statements. The results of our audit procedures, including the procedures performed to address the matters below, provide the basis for our audit opinion on the accompanying financial statements.

(a) Though the Institute is following "ACCRUAL" system of accounting continuously during the year under audit: -

(i) Transactions related to various recoveries out of the salary are recorded in the books of accounts on CASH basis as per management's decision.

(ii) Transactions related to interest on advances to employees are recorded in the books of accounts on CASH basis as per management's decision.

(iii) Transactions related to re-imbursement of telephone expenses to employees are recorded in the books of accounts on CASH basis as per management's decision.

(iv) Transactions relating to TDS under the GST laws are recorded in the books of accounts on CASH basis as per management's decision.

(v) Transactions related to Accrual Interest on all the Project Bank accounts are recorded in the books of accounts on CASH basis as per management's decision; and

(vi) Transactions related to all legal expenses related to court cases are recorded in the books of accounts on CASH basis as per management's decision.

ARIES while accepting the audit observation stated (September 2024) that it has implemented accrual system of accounting for above mentioned transactions from 01-04-2024.

(b) Rule 230 (8) of General Financial Rule, 2017 stipulates that *"all interests or other earnings against Grants in aid or advances (other than reimbursement) released to any Grantee institution should be mandatorily remitted to the Consolidated Fund of India immediately after finalization of the accounts"*. During the Financial Year 2022-23, the institute earned interest of Rs. 40,54,223 against grant in aid and not remitted such interest to DST.

(c) Property, Plant & Equipment (Fixed Asset) register, as kept by the institute, does not present head–wise, items-wise and year –wise /date–wise details related to Cost, Depreciation and Written Down Value of Property, plant & Equipment (Fixed Assets). We verified the schedule of Property, plant & Equipment (Fixed Assets) through account of the institute maintained on computer using "Tally –ERP-9" Software.

(d) A litigation was pending under Arbitration Tribunal regarding one legal claim filed by M/s Vidhyawati Construction Co. against the institute. The said legal claim has been decreed against the institute during the Financial Year 2021-2022 creating a demand of INR

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1,05,65,018/- plus interest by Arbitration Tribunal. The institute has filed an appeal against the order of Arbitration Tribunal in Commercial Court, Dehradun. The Institute has not made any provision in this regard in the financial year 2023-2024 in its Books of Account. All the legal expenses incurred on this claim amounting to INR 3,64,700/- have been shown as Expenses of the Institute during the financial year 2023-2024.

(e) Orders issued by the Income Tax Department show that the income tax cases pertaining to Assessment Year 2016-17 and 2018-19 are settled in favour of the institute. However, website of income tax department shows following outstanding demand which the institute has to pay to Income Tax Department:

Assessment Year	Demand Ref No	Amount (INR)	Interest accrued till 09-08-24
2016-17	20182016370432322 74T	2,67,81,900	39,02,072
2018-19	20202018370254963 42T	7,47,66,780	1,88,42,558
2018-19	20202018370254963 42T	1,87,830	Nil
Total		10,17,36,510	2,27,44,630

In this regard the necessary process is to initiate to close such outstanding demands appearing over income tax portal. Income tax department may adjust such tax demands from income tax refunds.

Moreover, the institute had pre-deposited income tax of Rs. 92,40,698/- against the notices issued by income tax authorities and now when the cases are settled in favour of institute, management is advised to apply income tax department for refund of such deposited tax amount.

ARIES while accepting the audit observation stated that the institute has initiated the process for removal of demands from income tax portal and recovery of deposited amount.

(f) Statutory liability towards NPS (Employer and Employee Share) in the case of "Ravinder Kumar, Ex. Registrar", amounting INR 18,98,728/- till 31st March 2024 has not been deposited to NPS department due to pending legal case in this regard.

(g) It was reported in the audit report of Financial Year 2022-23 that the institute has sold scrap of Rs. 6,46,000/- and has utilized credit available at GST portal for GST liability on sale of scrap. It was further reported that since the institute is exempt under the Income Tax Laws, credit availed on procurement cannot be utilized for GST liability. However, the institute has not deposited such GST liability of Rs. 98,542/- till the last date of Financial Year 2023-24.

ARIES while accepting the audit observation stated that the institute has deposited.

(h) Gratuity and leave encashment payable at the time of retirement of employees are defined retirement benefit plans which should be recognized in the financial statements based on present value of defined benefit obligations. It is observed that the auditee institute is recognizing present value of defined benefit obligations and booking those expenses at the time of retirement of employees only, it is suggested to recognize all

such benefits based on the present value of defined obligations which is computed using the projected unit credit method. For this purpose, actuarial valuation should be carried out at the end of each annual reporting period. Alternatively, the institute may subscribe to Gratuity, Superannuation and Leave Encashment schemes of renowned find managers like LIC.

(i) During the year under audit, the institute has incurred expenses on services which are chargeable to GST under the Reverse Charge Mechanism. However, GST is not paid by the institute on such services. Details of such services are as under:

Sl.No	Name of service	Expenditure Amount (Rs.)
1	Legal Services by advocate	5,12,010
2	Construction services supplied by Government departments like CPWD	14,99,45,220

(j) As per the accounting policy of the institute, recovery of advances including interest are recorded on cash basis. It is advisable to change policy to an accrual basis so as to record interest on advances applying the prescribed rates in the General Financial Rules as amended from time to time. For e.g., Interest rate on computer advance for the F.Y. 2023-24 is @ 9.1%.

(k) Matters relating to short deduction of TDS, labour cess and other compliances under the Tax Laws: It is observed in the following instances that TDS was not deducted at the time of making payments to suppliers:

i. As per provision 195 of Income Tax Act, 1961, any person responsible for paying to a non-resident, any other sum chargeable under the provisions of this Act shall, at the time of credit of such income to the account of the payee or at the time of payment thereof in cash or by the issue of a cheque or draft or by any other mode, whichever is earlier, deduct income-tax thereon at the rates in force. Further, Section 201 of the Act ibid provides that if any person, who is liable to deduct tax at source, does not deduct it or after so deducting fails to pay, the whole or any part of the tax to the credit of the Government, then, such person, shall be liable to pay simple interest at the rate of one per cent for every month or part of a month on the amount of such tax from the date on which such tax was deductible to the date on which such tax was deducted. ARIES paid a sum of Rs. 38,04,341/- to AMOS on 25-07-2023 for consultancy services. The services provided by AMOS are professional and technical in nature and were, therefore, subject to deduction of tax at source @ 10 per cent. We observed that tax at source was not deducted from the payments aggregating to 38,04,341/- made on 25-07-2023 to AMOS. Furthermore, as per Section 195 of the income tax Act, the details of making payments to Non-resident are required to be furnished in Form 15CA and Form 15CB. It is observed that the institute has not furnished Form 15CA and Form 15 CB before making payment of Rs. 38,04,341/- to AMOS.

S KAFALTIYA & ASSOCIATES Chartered Accountants FRN 0241 9C R HALDWANI

ii. As per section 194C of the Income-tax Act, Payments to contractors (1) Any person responsible for paying any sum to any resident (hereafter in this section re-ferred to as the contractor) for carrying out any work (including supply of labour for carrying out any work) in pursuance of a contract between the contractor and a specified person shall, at the time of credit of such sum to the account of the contractor or at the time of payment thereof in cash or by issue of a cheque or draft or by any other mode, whichever is earlier, deduct an amount equal to (i) one per cent where the payment is being made or credit is being given to an individual or a Hindu undivided family; (ii) two per cent where the payment is being made or credit is being given to a person other than an individual or a Hindu undivided family, of such sum as income-tax on income comprised therein.
However, from the records it revealed that no TDS was deducted by ARIES while making payment to contractors in the following cases:

Date of payment	Type of Work	Service Provider	Amount	Remark
26-6-2023	Civil work Devesthal	Payment to PWD Nainital/Anish Ahmad/CPWD Almora	34,70,678	Labour cess is also not deducted from the contractor
04-11-2023	Consumable electricals	SV Electronics	7,79,397	
23-08-2023	Cleaning work	Dronacharya sewa sansthan	16,260	
26-04-2023	Service charges	SIEMENS	20,650	TDS Should be deducted under section 194J (2%) prescribed for Technical services

iii. As per the provisions of Section 51 of CGST Act, (1) Notwithstanding anything to the contrary contained in this Act, the Government may mandate,- (a) a department or establishment of the Central Government or State Government; or (b) local authority; or (c) Governmental agencies; or (d) such persons or category of persons as may be notified by the Government on the recommendations of the Council, (hereafter in this section referred to as "the deductor"), to deduct tax at the rate of one per cent. from the payment made or credited to the supplier (hereafter in this section referred to as "the deductee") of taxable goods or services or both, where the total value of such supply, under a contract, exceeds two lakh and fifty thousand rupees. It further provides if any deductor fails to pay to the Government the amount deducted as tax under sub-section (1), he shall pay interest in accordance with the provisions of sub-section (1) of section 50, in addition to the amount of tax deducted.

Record reveals no TDS is deducted by the institute while making payment of Rs. 71,39,413/- to UPNL for security expenses.

(l) Provisions of Section 11 (2) of the income tax act,1961 (the Act) stipulates that *"Where eighty-five per cent of the income referred to in clause (a) or clause (b) of sub-section (1) read with the Explanation to that sub-section is not applied, or is not deemed to have been applied, to charitable or religious purposes in India during the previous year but is accumulated or set apart, either in whole or in part, for application to such purposes in India, such income so accumulated or set apart shall not be included in the total income of the previous year of the person in receipt of the income, provided the following conditions are complied with, namely-*

a) such person furnishes a statement in the prescribed form and in the prescribed manner to the Assessing Officer, stating the purpose for which the income is being accumulated or set apart and the period for which the income is to be accumulated or set apart, which shall in no case exceed five years;

b) the money so accumulated or set apart is invested or deposited in the forms or modes specified in sub-section (5);

c) the statement referred to in clause (a) is furnished at least two months prior to the due date specified under sub-section (1) of section 139 *for furnishing the return of income for the previous year*

***Provided** that in computing the period of five years referred to in clause (a), the period during which the income could not be applied for the purpose for which it is so accumulated or set apart, due to an order or injunction of any court, shall be excluded.*

Section 11(3) (b) of the Act further states that Any income referred to in sub-section (2) which-

a) .....

b) .....

c) is not utilised for the purpose for which it is so accumulated or set apart during the period referred to in clause (*a*) of that sub-section.

d) .....

shall be deemed to be the income of such person of the previous year-

i. .....

ii. .....

iii. being the last previous year of the period, for which the income is accumulated or set apart but not utilised for the purpose for which it is so accumulated or set apart under clause (c)

iv. .....

Income tax records of previous years, filed with the income tax department, reveals that the institute has accumulated or set apart a total amount of Rs. 6,50,02,953 and not utilised for the purpose for which such accumulations were made, till the date of balance sheet under audit. The institute has declared in the income tax returns that the amounts

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so accumulated are invested or deposited in the modes specified in section 11(5) of the Act. Details of such accumulations are as given below:

Year	Amount (Rs.)	Reference	Accumulation period expiring on
2020-21	2,48,28,000	Form No-10 dated 03.12.2021	31-03-2025
2021-22	4,01,74,953	Form No-10 dated 28.10.2022	31-03-2026

In this regard, management is advised to utilize above said accumulated and invested funds, supra, for the purpose for which it is accumulated on or before the time limit prescribed under section 11 (2) (a) of the Income Tax Act, 1961 otherwise the whole unutilized amount shall be deemed to be the income of the last year declared in respective Form 10.

Our opinion is not modified in respect of these matters.

(4) Responsibilities of Management for the Financial Statements:

The Institute's Management is responsible for the preparation and fair presentation of these financial statements that give a true and fair view of the financial position and financial performance of the Institute in accordance with the accounting principles generally accepted in India and the provisions of Rules & Regulation of the ARIES duly approved by Department of Science & Technology Government of India.

This responsibility also includes maintenance of adequate accounting records for safeguarding of the assets of the Institute and for preventing and detecting frauds and other irregularities; selection and application of appropriate accounting policies; making judgments and estimates that are reasonable and prudent; and design, implementation and maintenance of adequate internal financial controls, that were operating effectively for ensuring the accuracy and completeness of the accounting records, relevant to the preparation and presentation of the financial statements that give a true and fair view and are free from material misstatement, whether due to fraud or error.

In preparing the financial statements, management is responsible for assessing the Institute's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless management either intends to liquidate the Institute or to cease operations, or has no realistic alternative but to do so.
The management is also responsible for overseeing the Institute's financial reporting process.

(5) Auditor's Responsibilities for the Audit of the Financial Statements:

Our objective is to obtain reasonable assurance about whether the financial statements as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with SAs will always detect a

R S KAFALTIYA & ASSOCIATES Chartered Accountants FRN:024191C HALDWANI

material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis f these financial statements.

As part of an audit in accordance with SAs, we exercise professional judgment and maintain professional skepticism throughout the audit.

We also:

- Identify and assess the risks of material misstatement of the financial statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.
- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by management.
- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Institute's internal control.
- Conclude on the appropriateness of management's use of the going concern basis of accounting and based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Institute's ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the financial statements or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's report. However, future events or conditions may cause the Institute to cease to continue as a going concern.
- Evaluate the overall presentation, structure and control of the financial statements, including the disclosures, and whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation.

Materiality is the magnitude of misstatements of the financial statements that, individually or in aggregate, makes it probable that the economic decisions of the reasonably knowledgeable user of the financial statements may be influenced. We consider quantitative materiality and qualitative factors in (i) planning the scope of our audit work & evaluating the results of our work; and (ii) to evaluate the effect of any identified misstatements in the financial statements.

We communicate with those charged with governance regarding among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.

We also provide those charged with governance with a statement that we have complied with relevant ethical requirements regarding independence, and to communicate with them all

relationships and other matters that may reasonably be thought to bear on our independence and where applicable, related safeguards.

From the matters communicated with those charged with governance, we determine those matters that were of most significance in the audit of the financial statements for the financial year ended March 31, 2024 and are therefore the key Audit Matters. We describe these matters in our Auditor's Report unless law or regulation precludes public disclosure of these matters

(6) Other Matter:

Attention is drawn to the fact that the corresponding figures for the year ended March 31, 2024, are based on the previously issued audited financial statements of the Institute.
Our opinion is not modified in respect of these matters

(7) Report on Other Regulatory Requirements:

Further, we report that: -

a) We have obtained all the information and explanations which to the best of our knowledge and belief were necessary for the purpose of our audit subject to management representation letter;
b) In our opinion, proper books of account as required by law have been kept by the Institute so far as it appears from our examination of those books subject to management representation letter & key Audit Matters as reported in para (3) of this Audit Report; and
c) The Institute's Balance Sheet, the Statement of Income and Expenditure, and the Statement of Receipt & Payment dealt with by this Report are in agreement with the books of account, subject to management representation letter.

For R S KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS

R S KAFALTIYA & ASSOCIATES Chartered Accountants FRN:024191C HALDWANI

CA. RAMA SHANKAR KAFALTIYA
FCA PROPRITEOR
FRN- 024191C
MRN- 411796
UDIN: 24411796BKGSDI2342

Place: Haldwani
Dated: September 09, 2024

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

BALANCE SHEET AS AT 31st MARCH 2024

(Amount in "INR")

S. NO	PARTICULARS	Schedule	Current Year For the year ended 31st March 2024	Previous Year For the year ended 31st March 2023
	CAPITAL FUND AND LIABILITIES			
1	CAPITAL FUND	1	1,29,46,28,084.56	1,30,05,74,347.51
2	RESERVES AND SURPLUS	2	(70,62,874.05)	(56,76,772.05)
3	NON - CURRENT LIABILITIES:			
	EARMARKED/ ENDOWMENT FUNDS	3	9,84,24,472.06	8,77,57,428.06
	STAFF WELFARE FUND	3A	3,80,009.00	2,98,530.00
	PROJECT FUND	3B	1,15,08,162.49	1,38,91,753.28
4	SECURED LOANS AND BORROWINGS	4	-	-
5	UNSECURED LOANS AND BORROWINGS	5	-	-
6	DEFERRED CREDIT LIABILITIES	6	-	-
7	CURENT LIABILITIES AND PROVISIONS	7	3,40,23,053.70	3,91,46,824.70
	TOTAL LIABILITIES		1,43,19,00,907.76	1,43,59,92,111.50
	ASSETS			
9	PROPERTY, PLANT & EQUIPMENT	8	1,17,87,72,319.88	1,15,15,42,772.63
10	INVESTMENTS - FROM ENDOWMENT FUNDS	9	3,26,05,958.00	3,17,77,316.00
11	INVESTMENTS - OTHERS	10	25,75,930.00	37,73,560.00
12	CURRENT ASSETS, LOANS, ADVANCES ETS.	11	21,79,46,699.88	24,88,98,462.87
13	MISCELLANEOUS EXPENDITURE (to the extent not written off or adjusted)		-	-
	TOTAL ASSETS		1,43,19,00,907.76	1,43,59,92,111.50
14	SIGNIFICANT ACCOUNTING POLICIES	24		
15	CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

As per our separate Audit Report of even date attached.

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS

CA. RAMA SHANKAR KAFALTIYA, FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]

PLACE : HALDWANI
DATED : September 09, 2024

R.S. KAFALTIYA & ASSOCIATES * HALDWANI * Chartered Accountants FRN:024191C

For and on behalf of ARIES, Nainital

(REGISTRAR)
रजिस्ट्रार / Registrar
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
Aryabhatta Research Institute of Observational Sciences
एरीज, मनोरा पीक, नैनीताल– 263001
ARIES, Manora Peak, Nainital- 263 001

(DIRECTOR)
प्रो० दीपांकर बनर्जी / Prof. Dipankar Banerjee
निदेशक / Director
Aryabhatta Research Institute of Observational Sciences (ARIES)
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
मनोरा पीक, नैनीताल–263001 / Manora Peak, Nainital-263001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

STATEMENT OF INCOME AND EXPENDITURE FOR THE YEAR ENDED 31st March 2024

(Amount in "INR")

S. NO	PARTICULARS	SCH	Current Year For the year ended 31st March 2024	Previous Year For the year ended 31st March 2023
	(A) INCOMES:			
1	Income from Sales/Services	12	-	5,47,458.00
2	Grants/Subsidies - Establishment	13	17,48,56,025.00	17,15,00,000.00
	Grants/Subsidies - Other Admin Expenses	13A	14,44,00,000.00	9,43,00,000.00
3	Project Grants		-	-
4	Fees/Subscriptions	14	-	-
5	Income from Investments	15	12,42,845.00	11,54,646.00
6	Income from Royalty, Publication etc.	16	-	-
7	Interest Earned	17	54,91,702.00	42,24,831.00
8	Other Income	18	91,84,415.00	1,17,75,152.00
9	Increase/(decrese) in stock of Finished goods and works-in-progress	19	4,32,081.35	(2,76,648.40)
	TOTAL (A)		33,56,07,068.35	28,32,25,438.60
	(B) EXPENDITURES:			
10	Establishment Expenses	20	21,42,79,939.00	19,97,69,875.00
11	Other Administrative Expenses etc.	21	11,27,87,604.55	9,07,98,296.70
12	Expenditure on Projects	22	-	-
13	Interest Expenditures	23	37,38,096.00	39,13,289.00
	TOTAL (B)		33,08,05,639.55	29,44,81,460.70
	Balance being excess of Income / (Expenditure) (A - B)		48,01,428.80	(1,12,56,022.10)
14	Depreciation (corresponding to Sch 9)	8	(14,81,83,528.75)	(15,06,19,951.67)
15	Transfer to Special Reserve (Specify each)		-	-
16	Transfer to / from General Reserve			-
	BALANCE BEING SURPLUS/(DEFICIT) CARRIED TO CORPUS/ CAPITAL FUND		(14,33,82,099.95)	(16,18,75,973.77)
18	SIGNIFICANT ACCOUNTING POLICIES	24		
19	CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

As per our separate Audit Report of even date attached.

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS

CA. RAMA SHANKAR KAFALTIYA, FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]

PLACE : HALDWANI
DATED : September 09, 2024

R.S. KAFALTIYA & ASSOCIATES * HALDWANI * Chartered Accountants FRN:024191C

For and on behalf of ARIES, Nainital

(REGISTRAR) रजिस्ट्रार / Registrar
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
Aryabhatta Research Institute of Observational Sciences
एरीज, मनोरा पीक, नैनीताल– 263001
ARIES, Manora Peak, Nainital- 263 001

(DIRECTOR) प्रो० दीपांकर बनर्जी / Prof. Dipankar Banerjee
Aryabhatta Research Institute of Observational Sciences (ARIES)
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
मनोरा पीक, नैनीताल–263001 / Manora Peak, Nainital-263001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st March 2024

	SCHEDULE 1 - CAPITAL FUND		(Amount in "INR")
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2024 (Credit)	Previous Year For the year ended 31st March 2023 (Credit)
1	Balance as at the beginning of the year	1,30,05,74,347.51	1,29,00,50,321.28
2	Add : Contributions towards Capital Fund	17,17,00,000.00	17,24,00,000.00
3	Add / (Deduct) : Balance of net Income / - (Expenditure) transferred from the Income and Expenditure Account	(14,33,82,099.95)	(16,18,75,973.77)
4	Add / (Deduct) : Unspent Grant	(3,42,64,163.00)	-
	BALANCE AS AT THE YEAR - END	1,29,46,28,084.56	1,30,05,74,347.51

	SCHEDULE 2 - RESERVES AND SURPLUS		
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2024 (Credit)	Current Year For the year ended 31st March 2023 (Credit)
1	Capital Reserve :		
	As per last Account	-	-
	Addition / (Dedutions) during the year	-	-
2	Revaluation Reserve :		
	As per last Account	-	-
	Addition / (Dedutions) during the year	-	-
3	Special Reserves :		
	As per last Account	-	-
	Addition / (Dedutions) during the year	-	-
4	General Reserve :		
	As per last Account (31.03.2023)	(56,76,772.05)	(23,76,737.05)
	Additions during the year	(13,86,102.00)	(33,00,035.00)
	(Dedutions) during the year	-	-
	TOTAL	(70,62,874.05)	(56,76,772.05)

Annexed to the Balance Sheet of even date attached.

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS

CA. RAMA SHANKAR KAFALTIYA, FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]

PLACE : HALDWANI
DATED : September 09, 2024

R.S. KAFALTIYA & ASSOCIATES * HALDWANI * Chartered Accountants FRN:024191C

For and on behalf of ARIES, Nainital

(REGISTRAR)
रजिस्ट्रार / Registrar
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान

(DIRECTOR)
प्रो० दीपांकर बनर्जी / Prof. Dipankar Banerjee
निदेशक / Director
Aryabhatta Research Institute of Observational Sciences (ARIES)
एरीज, मनोरा पीक, नैनीताल– 263001
ARIES, Manora Peak, Nainital- 263 001
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
मनोरा पीक, नैनीताल–263001 / Manora Peak, Nainital-263001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st March 2024

	SCHEDULE 3A - STAFF WELFARE FUND		(Amount in "INR")
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2024 (Credit)	Previous Year For the year ended 31st March 2023 (Credit)
1	Balance as at the beginning of the year	2,98,530.00	83,567.50
2	ADD:		
	Staff Contribution Received	1,34,245.00	99,100.00
	Staff Contribution Received (Previous Years)	0.00	1,91,452.00
	Bank Interest	9,093.00	7,926.00
3	TOTAL STAFF WELFARE FUND VALUE (1 + 2)	4,41,868.00	3,82,045.50
4	LESS:		
	Staff Welfare Expenses	61,859.00	83,250.00
	Bank Expenses		265.50
	TOTAL STAFF WELFARE EXPENSES (4)	61,859.00	83,515.50
	BALANCE AS AT THE YEAR - END [3 - 4]	3,80,009.00	2,98,530.00

Annexed to the Balance Sheet of even date attached.

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS

CA. RAMA SHANKAR KAFALTIYA, FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]

R.S. KAFALTIYA & ASSOCIATES * HALDWANI * Chartered Accountants FRN:024191C

PLACE : HALDWANI
DATED : September 09, 2024

For and on behalf of ARIES, Nainital

(REGISTRAR)
रजिस्ट्रार / Registrar
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
Aryabhatta Research Institute of Observational Sciences
एरीज, मनोरा पीक, नैनीताल– 263001
ARIES, Manora Peak, Nainital- 263001

(DIRECTOR)
प्रो॰ दीपांकर बनर्जी / Prof. Dipankar Banerjee
निदेशक / Director
Aryabhatta Research Institute of Observational Sciences (ARIES)
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
मनोरा पीक, नैनीताल–263001 / Manora Peak, Nainital-263001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st March 2024

SCHEDULE 3 - EARMARKED/ENDOWMENT FUNDS

(Amount In "INR")

S.NO	PARTICULARS	Fund Wise Breakup				Current Year Total For the year ended 31st March 2024 (Credit)	Previous Year Total For the year ended 31st March 2023 (Credit)
		GPF Fund	GPF Reserve	Pension Fund	Pension Reserve		
A	Opening Balance of Funds	5,33,34,103.00	48,79,418.56	75,64,634.56	2,19,79,271.94	8,77,57,428.06	10,81,32,354.06
	Total (A)	5,33,34,103.00	48,79,418.56	75,64,634.56	2,19,79,271.94	8,77,57,428.06	10,81,32,354.06
B	Additions :						
	a) Employee's Contributions	51,06,780.00				51,06,780.00	68,25,932.00
	b) Interest Accrued	37,38,096.00				37,38,096.00	39,13,289.00
	c) Recoveries of Advances						
	d) Transferred from Reserve						
	e) Interest Contribution						-
	f) rplus						-
	g) le						-
	h) Endowment Su			1,07,67,285.00		1,07,67,285.00	-
	Pension Payab						-
	TOTAL (B) Other Credits*	88,44,876.00		1,07,67,285.00		1,96,12,161.00	1,07,39,221.00
C	Utilisation/Payments:						
	a) Capital Payments:			-		-	
	Transferred to GPF Fund	52,97,306.00				52,97,306.00	
	b) Revenue Payments:						
	-Permanent Withdrawls			36,47,811.00		36,47,811.00	1,25,81,904.00
	-Recoverable Advances						2,00,400.00
	-Retirement Payment						1,83,31,843.00
	-Advances of Previous yrs						-
	-Pension (Last year Prov)						
						-	
		52,97,306.00		36,47,811.00		89,45,117.00	3,11,14,147.00
						-	-
	NET BALANCE (A + B - C)	5,68,81,673.00	48,79,418.56	1,46,84,108.56	2,19,79,271.94	9,84,24,472.06	8,77,57,428.06
	TOTAL (C)					-	

* Pension Fund restated for payment of Leave encashment of Rs. 54,97,517/- Gratuity of Rs. 52,69,768/- during F.Y. 2022-23 which was made out of pension funds.

Annexed to the Balance Sheet of even date attached.

For R.S.KAFALTIYA & ASSOCIATES

CA
PROPRIETOR
[FRN - 024191C]
CHARTERED ACCOUNTANTS
[MRN - 411796]

PLACE : HALDWANI
DATED : September 09, 2024

RAMA SHANKAR KAFALTIYA,

FCA

For and on behalf of ARIES, Nainital

(DIRECTOR)

Aryabhatta Research Institute of Observational Sciences
एरीज, मनोरा पीक, नैनीताल– 263001
ARIES, Manora Peak, Nainital-263001

प्रो॰ दीपांकर बनर्जी / Prof. Dipankar Banerjee
निदेशक / Director
(Aryabhatta Research Institute of Observational Sciences (ARIES)
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
मनोरा पीक, नैनीताल–263001 / Manora Peak, Nainital-263001

रजिस्ट्रार / REGISTRAR
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st March 2024

SCHEDULE 3B- PROJECT FUND (Amount in "INR ")

S.NO	PARTICUALRS	Current Year For the year ended 31st March 2024 (Credit)	Previous Year For the year ended 31st March 2023 (Credit)
1	ISRO-GBP-ARFI PROJECT	)	6,89,526.00
2	ISRO - ATCTM PROJECT	8,50,401.54	48,08,149.54
3	ISRO-GBP-ABLN & C PROJECT	21,32,580.00	- 17,46,523.00
4	ST RADAR PROJECT	22,73,139.00	22,12,661.00
5	EMR-2016-1723 PROJECT	29,877.00	29,877.00
6	DST/INT/THAI/P-15-2019 PROJECT		1,08,445.50
7	UCOST - PM 2.5 PROJECT	78.45	4,140.45
8	SRG/SERB/2021 PROJECT		0.79
9	ADITYA-L 1 PROJECT	2,43,379.50	- 32,17,277.50
10	ASTRO-SAT-PROJECT	7,714.50	39,725.50
11	SRG/2022/001687	4,43,755.00	- 10,35,427.00
18	Project Account NPDF/2022/001040/SERB	2,24,474.00	
19	Project Account (UCOST)	1,60,000.00	
21	Project Fund A/c (INDO-THAI P-15/2019 PROJECT)	94,363.50	
21	Project Fund A/c (SRE-SERB)	2,64,284.00	-
23	SERB(SRS)/22-23/113	6,15,894.00	-
24	SRG/2023/002623 (SERB)	9,60,107.00	-
25	Miscellaneous Grants	32,08,115.00	-
	TOTAL		1,38,91,753.28 -
	Annexed to the Balance Sheet of even date attached.		-
	Project		-
For	R.S.KAFALTIYA & ASSOCIATES	1,15,08,162.49	
	ANTS	For and on behalf of ARIES, Nainital	

CA. RAMA KAR
PROPRIETOR
CHARTERED ACCOUNT
[MRN - 411798]

SHAN KAFALTIYA, FCA
PLACE : HALDWANI
DATED : September 09, 2024

(DIRECTOR)

रजिस्ट्रार / REGISTRAR

आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान दीपांकर बनर्जी / Prof. Dipankar Banerjee
Aryabhatta Research Institute of Observational Sciences निदेशक / Director
एरीज, मनोरा पीक, नैनीताल– 263001
ARIES, Manora Peak, Nainital- 263 001 आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st March 2024

SCHEDULE 4 - SECURED LOANS AND BORROWINGS (Amount in "INR")

S.NO	PARTICUALRS	Current Year For the year ended 31st March 2024 (Credit)	Previous Year For the year ended 31st March 2023 (Credit)
1	Central Government		
2	State Government	-	-
3	Financial Institutions	-	-
	a) Term Loans		
	b) Interest accrued and due	-	-
4	Banks:	-	-
	a) Term Loans	-	-
	Interest accrued and due		
	b) Other Loans	-	-
	Interest accrued and due	-	-
5	Other Institutions and Agencies	-	-
6	Debentures and Bonds	-	-
7	Others	-	-
	TOTAL	-	-
	Annexed to the Balance Sheet of even date attached.	-	-

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS

CA. RAMA SHANKAR
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]

PLACE : HALDWANI
DATED : September 09, 2024

KAFALTIYA, FCA
Chartered Accountants FRN:024191C
R. KAFALTIYA & ASSOCIATES HALDWANI

For and on behalf of ARIES, Nainital

(DIRECTOR)

आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान प्रो० दीपांकर बनर्जी / Prof. Dipankar Banerj
Aryabhatta Research Institute of Observational Sciences निदेशक / Director
एरीज, मनोरा पीक, नैनीताल– 263001 Aryabhatta Research Institute of Observational Sciences (A
ARIES, Manora Peak, Nainital-263001 रजिस्ट्रार / Registrar प्रेक्षण विज्ञान शोध संस्थान (एरीज)
रजिस्ट्रार / Registrar मनोरा पीक, नैनीताल-263001 / Manora Peak, Nainital-26

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st March 2024

	SCHEDULE 5 - UNSECURED LOANS AND BORROWINGS		(Amount in "INR")
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2024 (Credit)	Previous Year For the year ended 31st March 2023 (Credit)
1	Central Government	-	-
2	State Government (Specify)	-	-
3	Financial Institutions	-	-
4	Banks:		
	a) Term Loans	-	-
	b) Other Loans (specify)	-	-
5	Other Institutions and Agencies	-	-
6	Debentures and Bonds	-	-
7	Fixed Deposits	-	-
8	Others (Specify)	-	-
	TOTAL	-	-

	SCHEDULE 6 - DEFERRED CREDIT LIABILITIES		(Amount in "INR")
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2024 (Credit)	Previous Year For the year ended 31st March 2023 (Credit)
1	Acceptances secured by hypothecation of Capital Equipments and other assets	-	-
2	Others	-	-
	TOTAL	-	-

Annexed to the Balance Sheet of even date attached.

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS

CA. RAMA SHANKAR KAFALTIYA, FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]

PLACE : HALDWANI
DATED : September 09, 2024

R.S. KAFALTIYA & ASSOCIATES * HALDWANI * Chartered Accountants FRN:024191C

For and on behalf of ARIES, Nainital

(REGISTRAR)

(DIRECTOR)

आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
AryabhattaResearch Institute of Observational Sciences
एरीज, मनोरा पीक, नैनीताल– 263001
ARIES, Manora Peak, Nainital - 263 001

प्रो० दीपांकर बनर्जी / Prof. Dipankar Banerjee
निदेशक / Director
Aryabhatta Research Institute of Observational Sciences (ARIES
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
मनोरा पीक, नैनीताल–263001 / Manora Peak, Nainital-263001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st March 2024

SCHEDULE 7 - CURRENT LIABILITIES AND PROVISIONS (Amount in "INR")

S.NO	PARTICULARS	Current Year For the year ended 31st March 2024 (Credit)	Current Year (Credit)	Previous Year For the year ended 31st March 2023 (Credit)	Previous Year (Credit)
	A. CURRENT LIABILITIES:				
1	Acceptances	-	-	-	-
2	Sundry Creditors (YAM)	21,558.00	21,558.00	1,40,300.00	1,40,300.00
3	Advances Received - Scientific Meeting	-	-	-	-
4	Interest accrued but not due on:				
	a) Secured Loans /borrowings	-		-	
	b) Unsecured Loans/borrowings	-	-	-	-
5	Interest on SBI (Director's) Bank A/C - 253				
	- Financial Year 2023-24	40,83,681.00			
	- Financial Year 2022-23	40,54,223.00	81,37,904.00	40,54,223.00	40,54,223.00
6	Statutory Liabilities:				
	a) GST under Reverse Charge and Scrap	98,542.00		98,542.00	
	b) GST TDS Payable	6,11,190.00		-	
	c) TDS Payable	3,72,599.00		14,24,593.00	
	d) Labour Cess (March 2023)	64,160.00		29,678.00	
	e) NPS (Employee's Contribution)	(2,00,402.00)		(2,00,402.00)	
	f) NPS (Employer's Contribution)	(26,541.00)		(26,541.00)	
	g) NPS of R.Kumar (Employee Contribution)	8,41,951.00		8,27,416.00	
	h) NPS of R.Kumar (Employer Contribution)	10,56,777.00	28,18,276.00	10,36,428.00	31,89,714.00
7	Other Curent Liabilities:				
	a) Earnest Money Deposits	40,000.00		40,000.00	
	b) Performance Security Deposits	7,93,989.00		11,32,287.00	
	c) Other Securities - RSD -Devakinandan	-		10,87,728.00	
	c) Other Securities - Mahi Traders	53,787.00		69,531.00	
	e) Other Securities - Kandpal Buildcare	28,577.00		-	
	f) Misc. Project Grant to be transferred (Grants received but neither allocated to project(s) nor transferred to related Bank Account(s)			62,90,975.00	
	g) Outstanding Expenses*	1,92,18,597.00		1,94,56,831.00	
	h) Group Insurance	(1,020.00)		(600.00)	
	i) G. N. Pathak - Pensioner	39,774.00		39,774.00	
	j) L S kanwal - Pensioner	12,071.00		12,071.00	
	k) Shyam Girl - Pensioner	7,243.00		7,243.00	
	l) Abhiskek Yadav	-		70,000.00	
	m) Staff Welfare Payable	150.00		150.00	
	n) Contingency Expenses (CSIR)	88,438.00		88,438.00	
	o) Ashoka Construction	1,74,000.00		-	
	p) CGM Computers	20,000.00		-	
	q) PR Sales	20,600.00		-	
	r) Contingency Project Payable	59,993.00		-	
	s) Election TA Bills	1,855.00		-	
	t) Environment-SA	48,000.00		-	
	u) Rahul Sirohi	50,500.00		-	
	v) Extraneous Credits*	23,88,761.70	2,30,45,315.70	34,68,159.70	3,17,62,587.70
	TOTAL (A)		3,40,23,053.70		3,91,46,824.70
	B. PROVISIONS :				
1	Taxation		-		-
2	Gratuity		-		-
3	Accumulated Leave Encashment		-		-
4	Others (Specify)		-		-
	TOTAL (B)		-		-
	TOTAL (A+B)		3,40,23,053.70		3,91,46,824.70

* Separate List Attached.

Annexed to the Balance Sheet of even date attached.

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS

CA. RAMA SHANKAR KAFALTIYA, FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]

PLACE : HALDWANI
DATED : September 09, 2024

R.S. KAFALTIYA & ASSOCIATES * HALDWANI * Chartered Accountants FRN:024191C

For and on behalf of ARIES, Nainital

(REGISTRAR)

(DIRECTOR)

प्रो० दीपांकर बनर्जी / Prof. Dipankar Banerjee
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आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
Aryabhatta Research Institute of Observational Sciences (ARIES)
एरीज, मनोरा पीक, नैनीताल-- 263001
ARIES, Manora Peak, Nainital- 263 001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL
SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st March 2024

SCHEDULE 8 - PROPERTY, PLANT & EQUIPMENT:

(Amount in "INR")

S.NO.	DESCRIPTION	Rate	GROSS BLOCK					DEPRECIATION				NET BLOCK	
			Cost/valuation As at beginning of the year (01.04.2023)	Additions During the Year (> 180 days)	Additions During the Year (< 180 days)	Sales/Deductions / W-off during the year	Cost/valuation at the year end (31.03.2024)	As at the beginning of the year (01.04.2023)	On (Op. WDV + Additions -Sale/Ded/W-off (> 180 days) - Deductions)	On Additions During the Year (< 180 days)	Total Depreciation up to the year end (31.03.2024)	As at the Current Year end (31.03.2024)	As at the Previous Year end (31.03.2023)
			(1)	(2)	(3)	(4)	5 (1+2+3-4)	(6)	(7)	(8)	9 (7+8)	10 (5-9)	(11)
I A	PROPERTY, PLANT & EQUIPMENT:												
	LAND:	Nil											
	Land		10,58,50,429.00	-	-	-	10,58,50,429.00	-	-	-	-	10,58,50,429.00	10,58,50,429.00
	TOTAL (A)		10,58,50,429.00	-	-	-	10,58,50,429.00	-	-	-	-	10,58,50,429.00	10,58,50,429.00
B	BUILDINGS & INFRASTRUCTURES	10%											
	Building 3.60 Telescope		3,46,01,869.00	-	-	-	3,46,01,869.00	1,97,89,783.93	14,81,238.51	-	2,12,70,992.43	1,33,30,876.57	1,48,12,085.07
	Building Non-Res (Devsthal)		2,85,27,064.00	-	-	-	2,85,27,064.00	1,37,73,410.14	15,25,365.99	-	1,47,98,776.13	1,37,28,288.87	1,52,53,653.86
	Building Non-Res (Manora Peak)		11,53,24,344.00	-	71,05,843.00	-	11,74,30,187.00	8,38,35,686.10	31,48,865.79	1,05,492.15	8,70,89,994.04	3,03,40,192.96	3,14,88,657.90
	Building 4 MT Telescope		2,54,69,905.00	-	-	-	2,54,69,905.00	25,46,980.60	22,92,201.45	-	48,39,282.05	2,06,30,622.95	2,29,22,924.40
	Infrastructure Dev. (Dev Sthal)		5,00,72,786.90	3,80,000.00	18,35,237.00	-	5,18,94,023.90	2,99,57,661.50	20,50,112.54	51,781.85	3,20,59,535.89	1,98,34,488.01	2,01,15,125.40
	Infrastructure Dev. (Manora Peak)		2,37,05,307.70	67,36,545.00	11,53,800.00	1,43,70,906.00	1,72,24,746.70	1,10,88,617.70	19,35,323.50	57,690.00	1,30,81,631.20	41,43,115.50	1,26,16,690.00
	Roads at Devsthal		2,28,89,364.00	1,36,66,200.00	99,39,200.00	-	4,64,54,564.00	1,64,40,205.76	20,07,515.82	4,96,960.00	1,89,44,681.58	2,75,09,882.42	64,08,958.24
	TOTAL (B)		30,05,50,440.60	2,07,82,745.00	1,42,37,080.00	1,43,70,906.00	32,12,05,359.60	17,69,32,355.63	1,44,40,683.00	7,11,894.00	19,20,84,892.62	12,91,20,466.98	12,36,18,084.97
C	Buildings - Residential	5%											
	Guest House (Devsthal)		12,24,022.00	-	-	-	12,24,022.00	6,63,453.38	28,028.43	-	6,91,481.81	5,32,540.19	5,60,568.62
	Building Residential (Manora Peak)		3,10,67,683.60	-	94,88,605.00	-	4,05,56,288.60	1,28,69,740.97	9,09,887.14	2,37,215.13	1,40,16,843.22	2,65,39,445.38	1,81,97,942.63
	TOTAL (C)		3,22,91,705.60	-	94,88,605.00	-	4,17,80,310.60	1,35,33,194.34	9,37,915.56	2,37,215.13	1,47,08,325.03	2,70,71,985.57	1,87,58,511.26
D	VEHICLES	15%											
	Vehicle		74,67,053.10	-	-	-	74,67,053.10	41,66,467.50	4,95,087.84	-	46,61,555.34	28,05,497.76	33,00,585.60
	TOTAL (D)		74,67,053.10	-	-	-	74,67,053.10	41,66,467.50	4,95,087.84	-	46,61,555.34	28,05,497.76	33,00,585.60
E	FURNITURE AND FIXTURES	10%											
	Furniture & Fixture		3,66,40,399.70	5,88,724.00	33,01,431.00	-	4,05,30,554.70	1,02,48,557.94	26,98,056.58	1,65,071.55	1,31,11,686.07	2,74,18,868.63	2,63,91,841.76
	TOTAL (E)		3,66,40,399.70	5,88,724.00	33,01,431.00	-	4,05,30,554.70	1,02,48,557.94	26,98,056.58	1,65,071.55	1,31,11,686.07	2,74,18,868.63	2,63,91,841.76
F	OFFICE EQUIPMENTS	10%											
	Office Equipment		52,08,091.25	25,62,949.00	7,41,902.00	-	85,12,942.25	16,83,559.66	6,08,748.06	37,095.10	23,29,402.82	61,83,539.43	35,24,531.59
	TOTAL (F)		52,08,091.25	25,62,949.00	7,41,902.00	-	85,12,942.25	16,83,559.66	6,08,748.06	37,095.10	23,29,402.82	61,83,539.43	35,24,531.59
G	COMPUTER/PERIPHERALS	40%											
	Computer & Peripherals		8,54,66,652.40	21,35,535.00	25,48,212.00	21,47,395.00	8,80,03,002.40	6,20,17,659.52	93,74,853.95	5,09,642.98	7,19,02,156.47	1,61,00,850.53	2,34,48,984.88
	Computer Software		1,16,24,661.24	10,62,649.00	13,18,256.00	-	1,40,05,566.24	67,55,848.99	73,72,584.50	2,63,861.20	93,92,694.69	46,13,481.55	48,68,812.25
	TOTAL (G)		9,70,91,313.64	31,98,184.00	38,66,468.00	21,47,395.00	10,20,08,568.64	6,87,73,508.50	1,67,47,438.45	7,73,504.50	8,12,94,851.16	2,07,14,332.08	2,83,17,807.14
H	ELECTRIC INSTALLATIONS	15%											
	Electrical (Non-Consumable)		2,09,97,501.00	28,03,083.00	13,86,933.00		2,51,87,517.00	51,47,769.21	27,98,672.29	1,04,019.98	80,45,461.49	1,71,42,055.50	1,58,54,731.79
	Electric Installation (Devasthal)		79,17,277.00	2,84,000.00			82,01,277.00	43,12,140.65	5,83,370.45	-	48,95,511.10	33,05,765.90	36,05,136.35
	Electric Installation (Manora Peak)		2,06,71,987.72	12,50,887.00	76,47,936.00		2,95,69,910.72	1,06,53,820.67	16,90,358.11	5,73,527.70	1,29,17,706.48	1,66,52,204.24	1,00,18,167.05
	Electronic Section		92,40,897.55				92,40,897.55	84,74,344.13	1,14,983.01	-	85,89,327.14	6,51,570.41	7,66,553.42
	Electronic Substation-DOT 3.6 Mt		7,11,88,424.00				2,11,88,424.00	48,56,192.81	24,49,894.66	-	73,06,027.49	1,38,82,396.51	1,63,32,231.19
	Solar Section		6,380.79				6,380.79	6,380.79	-	-	6,380.79	-	-
	TOTAL (H)		8,00,22,468.06	43,37,970.00	90,33,969.00	-	9,33,94,407.06	3,34,45,648.26	76,37,218.47	6,77,547.68	4,17,60,414.40	5,16,33,992.66	4,65,76,819.80
I	LIBRARY BOOKS	40%											
	Library Books		6,00,74,717.50	93,343.00	10,045.00	-	6,01,78,105.50	5,87,99,680.15	5,47,352.14	2,009.00	5,93,49,041.29	8,29,064.21	12,75,037.35
	TOTAL (I)		6,00,74,717.50	93,343.00	10,045.00	-	6,01,78,105.50	5,87,99,680.15	5,47,352.14	2,009.00	5,93,49,041.29	8,29,064.21	12,75,037.35

Continued to page - 2-

R S KAFALTIYA & ASSOCIATES
Chartered Accountants
FRN:024191C
HALDWANI

रजिस्ट्रार / Registrar
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
Aryabhatta Research Institute of Observational Sciences
एरीज, मनोरा पीक, नैनीताल– 263001
ARIES, Manora Peak, Nainital- 263 001

D. Banerjee
प्रो० दीपांकर बनर्जी / Prof. Dipankar Banerjee
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आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
मनोरा पीक, नैनीताल–263001 / Manora Peak, Nainital-263001

S.NO.	DESCRIPTION	Rate	GROSS BLOCK: Cost/valuation As at beginning of the year (01.04.2023)	Additions During the Year (> 180 days)	Additions During the Year (< 180 days)	Sales/Deductions / W-off during the year	Cost/valuation at the year end (31.03.2023)	DEPRECIATION: As at the beginning of the year (01.04.2023)	On (Op. WDV + Additions -Sale/Ded/W-off (> 180 days) - Deductions)	On Additions During the Year (< 180 days)	Total Depreciation up to the year end (31.03.2023)	NET BLOCK: As at the Current Year end (31.03.2023)	As at the Previous Year end (31.03.2022)
			(1)	(2)	(3)	(4)	5 (1+2+3-4)	(6)	(7)	(8)	9 (7+8)	10 (5-9)	(11)
J	PLANT MACHINERY & EQUIPMENT	15%											
	Telescope - DOT 3.6 Mt		1,29,11,63,101.00				1,29,11,63,101.00	85,76,78,899.65	6,55,77,636.20	-	91,35,56,495.86	37,76,06,605.14	43,71,84,241.35
	Telescope - 1.3 MT		9,22,77,149.00				9,22,77,149.00	7,50,69,917.55	25,81,397.47	-	7,76,50,938.02	1,46,26,210.98	1,72,07,316.45
	Telescope		1,60,16,768.55				1,60,16,768.55	90,32,468.42	10,50,570.47	-	1,00,83,538.89	59,53,232.66	70,03,809.13
	Backend Instrument -Modernization		16,46,39,367.00				16,46,39,367.00	9,84,79,267.73	59,24,014.89	-	10,84,03,282.62	5,62,36,084.38	6,61,60,099.27
	Backend Instrument I - ADFOSC		52,41,235.00				52,41,235.00	32,52,715.45	2,98,277.99	-	35,50,993.38	16,90,241.62	19,88,519.55
	Instruments		10,94,95,384.67				10,94,95,384.67	8,92,33,078.22	30,39,345.97	-	9,22,72,424.18	1,72,22,960.49	2,02,62,306.45
	Aluminisation Plant (Devsthal)		3,95,23,736.00				3,95,23,736.00	2,68,53,431.70	19,00,560.64	-	2,87,54,882.35	1,07,69,843.65	1,26,70,404.30
	LIDAR Project		93,82,289.00				93,82,289.00	78,38,769.79	2,78,524.88	-	81,17,294.67	12,64,994.33	15,43,519.21
	Optics		1,22,13,482.80	8,33,320.00	80,36,492.00	11,84,720.00	1,48,98,574.80	77,91,355.96	16,13,017.03	2,27,736.00	96,32,109.00	52,67,464.91	99,20,126.84
	High Resolution Spectrograph (HRS)		2,27,49,507.00	3,67,21,875.00	2,44,96,640.00	-	8,39,68,022.00	48,56,294.62	84,87,763.11	18,37,248.00	1,48,81,305.73	6,90,86,716.27	1,78,93,212.38
	CSNOT-09 - 4.2 IUMT Project		5,80,366.00	1,39,725.00	-	-	7,20,091.00	1,64,302.48	98,128.52	-	2,64,029.40	5,56,061.60	5,14,465.12
	CSNOT-05 - WB-02 (ASTRAD)		52,65,485.00	23,700.00	97,47,865.00	-	60,36,350.00	1,32,342.00	1,73,451.45	3,56,074.88	6,61,868.33	53,74,481.68	11,43,143.00
	Telescope (Schmidt)		1,07,39,623.00	-	-	-	1,07,39,623.00	86,16,899.18	1,68,258.57	-	87,85,157.76	19,53,465.24	21,21,723.82
	Planetarium (Public Outreach)		89,18,714.00	70,28,339.00	37,84,458.00	-	87,31,511.00	31,47,219.41	2,69,975.04	2,83,834.35	37,01,028.80	50,30,482.20	7,71,494.59
	Projector (Public Outreach)		1,05,300.00	-	-	-	1,05,000.00	88,746.54	2,438.02	-	91,184.56	13,815.44	16,253.46
	Spectrometer		10,62,951.00	-	-	-	10,62,951.00	4,92,126.70	55,623.64	-	7,47,750.35	3,15,200.65	3,70,824.30
	Telescope (Public Out Reach)		6,07,295.00	-	4,55,100.00	-	1,02,295.00	5,20,912.05	12,957.44	37,125.00	5,70,994.49	5,31,300.51	86,382.95
	Telescope Solar		20,16,145.00	-	-	-	20,16,145.00	14,71,425.27	89,207.86	-	15,10,633.23	5,05,511.77	5,44,719.73
	ST RADAR		18,64,642.00	-	-	-	18,64,642.00	8,91,287.04	1,46,003.24	-	10,37,290.28	8,27,351.72	9,73,354.96
	ASTRAD - CSNOT-05		1,77,17,687.00	5,96,000.00	43,03,920.00	-	2,26,17,607.00	55,63,784.05	19,12,515.44	3,22,794.00	77,99,093.49	1,48,18,513.51	2,21,54,192.95
	Telescope Enclosure - 3.6 MT		1,68,04,927.00	3,09,382.00	38,87,490.00	-	2,09,86,199.00	88,03,895.35	35,46,592.05	2,91,186.75	1,26,41,674.15	83,44,524.85	1,00,01,031.65
	Coating Plant-40 inch		-	-	23,56,985.00	-	23,56,985.00	-	-	1,76,773.88	1,76,773.88	21,80,211.13	-
	TOTAL (J)		1,81,98,51,453.02	3,96,51,841.00	4,71,03,650.00	11,84,720.00	1,90,49,22,224.02	1,19,98,30,227.57	9,88,75,659.97	35,32,773.75	1,30,22,38,961.29	60,26,83,262.73	61,99,21,225.45
K	OTHER FIXED ASSETS	15%											
	Aluminising / Anodising		89,358.67	-	-	-	89,358.67	89,358.67	-	-	89,358.67	-	-
	Atmospheric Science Division (ASD)		79,87,565.00	11,62,702.00	27,79,852.00	-	1,19,25,119.00	11,04,208.16	12,06,158.83	2,08,468.90	25,18,835.88	94,06,283.12	68,78,356.84
	Canteen Assets		8,76,009.00	69,963.00	17,837.00	-	9,63,809.00	1,73,093.37	1,15,934.79	1,327.78	2,90,365.94	6,73,463.06	7,02,915.63
	CCTV Camera		77,500.00	-	-	-	77,500.00	50,463.01	4,055.55	-	54,518.56	22,981.44	27,036.99
	Gym Assets		4,67,862.00	-	-	-	4,67,862.00	1,17,903.83	52,493.73	-	1,70,397.55	2,97,464.45	3,49,958.18
	Library Instrument		9,500.00	-	-	-	9,500.00	6,454.44	456.83	-	6,911.27	2,588.73	3,045.56
	Workshop Assets		1,30,27,571.45	8,17,470.00	29,61,932.00	-	1,68,07,373.45	22,07,693.75	17,45,681.25	2,22,144.90	41,75,505.91	1,26,31,867.54	1,08,75,771.70
	Hostel Assets		5,26,873.00	-	-	-	5,26,873.00	1,28,374.35	61,274.80	-	1,89,649.14	3,37,223.86	4,08,498.65
	Guest House Assets		4,52,030.00	3,59,933.00	5,36,640.00	-	13,48,603.00	89,639.28	1,08,349.46	48,248.00	2,46,236.74	11,10,372.26	3,62,390.72
	EPABX Telephone Assets		1,51,000.00	-	7,24,000.00	-	8,75,000.00	11,325.00	20,951.25	54,300.00	86,576.25	7,88,423.75	1,39,675.00
	Project Assets		27,62,966.00	-	-	-	27,62,966.00	13,20,680.54	2,16,947.82	-	15,37,628.36	12,25,342.64	14,42,285.46
	TOTAL (K)		2,64,33,641.12	24,10,068.00	70,20,261.00	-	3,58,63,990.12	52,99,200.40	35,31,679.31	5,26,539.58	93,57,399.28	2,65,06,590.84	2,11,34,440.72
	TOTAL OF CURRENT YEAR (J)		2,57,09,81,710.59	7,36,31,844.00	9,48,03,431.00	1,77,03,924.00	2,72,17,33,944.59	1,57,27,12,395.96	14,15,20,149.38	66,63,379.38	1,72,08,95,924.71	1,00,08,18,019.88	99,82,69,314.63
	TOTAL OF PREVIOUS YEAR (J)		2,45,64,98,668.59	4,06,99,528.00	6,37,83,514.00	-	2,57,09,81,710.59	1,42,20,92,444.29	14,42,31,761.44	63,88,190.23	1,57,27,12,395.96	99,82,69,314.63	1,04,44,06,224.30
2	CAPITAL WORK-IN-PROGRESS												
A	Advance CWIP (Const Devasthal)		13,85,13,378.00	2,00,00,000.00	12,99,45,270.00	31,15,98,178.00	17,68,60,470.00	-	-	-	-	17,68,60,470.00	13,85,13,378.00
B	Advance Rural Works Department		1,36,66,200.00	-	-	1,36,66,200.00	-	-	-	-	-	-	1,36,66,200.00
C	Astro Park and Science Centre		10,93,880.00	-	-	-	10,93,880.00	-	-	-	-	10,93,880.00	10,93,880.00
	TOTAL (2)		15,32,73,458.00	2,00,00,000.00	12,99,45,270.00	12,52,64,378.00	17,79,54,300.00	-	-	-	-	17,79,54,300.00	15,32,73,458.00
	GRAND TOTAL (1 + 2)		2,72,42,35,168.59	9,36,31,844.00	22,47,48,633.00	14,29,67,399.00	2,89,96,58,244.59	1,57,27,12,395.96	14,15,20,149.38	66,63,379.38	1,72,08,95,924.71	1,17,87,72,319.88	1,15,15,42,772.63

Annexed to the Balance Sheet of even date attached.

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS
CA, RAMASHANKAR KAFALTIYA, FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]
PLACE : HALDWANI
DATED : September 09, 2024

R.S. KAFALTIYA & ASSOCIATES * HALDWANI * Chartered Accountants FRN:024191C

For and on behalf of ARIES, Nainital

(REGISTRAR) रजिस्ट्रार/Registrar
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
Aryabhatta Research Institute of Observational Sciences
एरीज, मनोरा पीक, नैनीताल– 263001
ARIES, Manora Peak, Nainital- 263 001

(DIRECTOR)
प्रो० दीपांकर बनर्जी / Prof. Dipankar Banerjee
निदेशक / Director
Aryabhatta Research Institute of Observational Sciences (ARIES)
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
मनोरा पीक, नैनीताल–263001 / Manora Peak, Nainital-263001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st March 2024

	SCHEDULE 9 - INVESTMENTS FROM EARMARKED/ENDOWMENT FUNDS		(Amount in "INR")
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2024 (Debit)	Previous Year For the year ended 31st March 2023 (Debit)
1	In Government Securities	-	-
2	Other approved Securities	-	-
3	Shares	-	-
4	Debentures and Bonds	-	-
5	Subsidiaries and joint Ventures	-	-
6	Others (to be specified):		
	a) FDR (GPF A/C) with Scheduled Bank (SBI)	3,26,05,958.00	3,17,77,316.00
	b) FDR (Pension Fund A/C) with Scheduled Bank (UBI)	-	-
	c) Interest Accrued	-	-
	TOTAL	3,26,05,958.00	3,17,77,316.00

	SCHEDULE 10 - INVESTMENTS - OTHERS		
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2024 (Debit)	Current Year For the year ended 31st March 2023 (Debit)
1	In Government Securities	-	-
2	Other approved Securities	-	-
3	Shares	-	-
4	Debentures and Bonds	-	-
5	Subsidiaries and Joint Ventures	-	-
6	Others (to be specified):		
	a) FDR (ST RADAR Project) with Scheduled Bank (SBI)	25,75,930.00	24,57,625.00
	b) FDR (ISRO Project) with Scheduled Bank (SBI)	-	13,15,935.00
	c) Interest Accrued	-	-
	TOTAL	25,75,930.00	37,73,560.00

Annexed to the Balance Sheet of even date attached.

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS

CA. RAMA SHANKAR KAFALTIYA, FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]

PLACE : HALDWANI
DATED : September 09, 2024

R.S. KAFALTIYA & ASSOCIATES * HALDWANI * Chartered Accountants FRN:024191C

For and on behalf of ARIES, Nainital

(REGISTRAR) रजिस्ट्रार / Registrar
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
Aryabhatta Research Institute of Observational Sciences
एरीज, मनोरा पीक, नैनीताल– 263001
ARIES, Manora Peak, Nainital-263001

(DIRECTOR) प्रो. दीपांकर बनर्जी / Prof. Dipankar Banerjee
निदेशक / Director
Aryabhatta Research Institute of Observational Sciences (ARIES)
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
मनोरा पीक, नैनीताल–263001 / Manora Peak, Nainital-263001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st March 2024

	SCHEDULE 11 (A) - CURRENT ASSETS, LOANS, ADVANCES ETC.			(Amount in "INR")	
S.NO	PARTICUALRS	Current Year		Previous Year	
		For the year ended 31st March 2024		For the year ended 31st March 2023	
		(Debit)	(Debit)	(Debit)	(Debit)
	A. CURRENT ASSETS				
1	**Inventories:**				
	a) Finished Goods		-		-
	b) Work in Progress		-		-
	c) Consumables				
	-Stores and Spares	17,10,361.22		17,98,935.00	
	-Stationary	2,66,907.41		4,06,886.00	
	-Computer Accessories	8,63,877.20		2,50,913.00	
	-Postage Stamps	10,039.00		6,975.00	
	-Fuel (POL)	7,59,005.52	36,10,190.35	7,14,400.00	31,78,109.00
2	**Sundry Debtors:**				
	a) Debts Outstanding > six months	-		-	
	b) Others	-	-	-	-
3	**Cash balances in hand** (including cheques/drafts)		-		10,728.00
4	**Bank Balances:**				
	a) With Scheduled Banks:				
	Current Accounts	-		-	
	Deposit Accounts (LC) *	39,00,032.00		37,00,000.00	
	Savings Account *				
	-Director A/C	8,44,42,752.74		12,30,41,231.21	
	-Pension Fund A/C	7,25,65,948.72		6,87,91,038.72	
	-GPF A/C	1,26,87,536.30		1,25,69,647.30	
	-Canteen A/C	2,15,851.99		2,10,107.99	
	-Staff Welfare Fund A/C	3,80,009.00		2,98,530.00	
	-Project Bank A/Cs	74,64,024.49	18,16,56,155.24	98,36,104.28	21,84,46,659.50
	b) With Non-Scheduled Banks:		-		-
5	Post Office-Savings Accounts		-		-
	TOTAL (A)		18,52,66,345.59		22,16,35,496.50

* Separate List Attached.

Annexed to the Balance Sheet of even date attached.

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS

CA. RAMA SHANKAR KAFALTIYA, FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]

PLACE : HALDWANI
DATED : September 09, 2024

R.S. KAFALTIYA & ASSOCIATES * HALDWANI * Chartered Accountants FRN:024191C

For and on behalf of ARIES, Nainital

रजिस्ट्रार / (REGISTRAR)
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
Aryabhatta Research Institute of Observational Sciences
एरीज, मनोरा पीक, नैनीताल– 263001
ARIES, Manora Peak, Nainital-263001

प्रो० दीपांकर बनर्जी / Prof. Dipankar Banerjee (DIRECTOR)
निदेशक / Director
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
मनोरा पीक, नैनीताल–263001 / Manora Peak, Nainital-263001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st March 2024

	SCHEDULE 11 (B) - CURRENT ASSETS, LOANS, ADVANCES ETC.				(Amount in "INR")
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2024		Previous Year For the year ended 31st March 2023	
		(Debit)	(Debit)	(Debit)	(Debit)
	B. Loans, Advances & Other Assets				
1	Loans:				
	a) Staff	79,36,565.00		50,07,866.00	
	b) Others (specify)	-	79,36,565.00	-	50,07,866.00
2	Advances and other amounts (recoverable in cash or in kind)				
	a) On Capital Accounts (EE(PWD))	7,69,200.00		7,69,200.00	
	b) Pre-paid Expenses	14,91,802.00		17,07,291.08	
	c) Extraneous Debits*	3,91,921.00		21,42,614.00	
	d) TDS receivables	10,13,122.00		4,32,036.00	
	e) Security Deposit	54,212.00		54,212.00	
	g) Imprest Advances	-		-	
	h) Harsh PG Hostel	-		11,000.00	
	i) DST Research and Development	18,90,483.00		-	
	j) Meeting Advance (IUSSTF Award)	2,53,206.29		2,53,206.29	
	k) Income Tax Deposit	92,40,698.00	1,51,04,644.29	92,40,698.00	1,46,10,257.37
3	Income Accured On:				
	a) Investments - Endowment Funds				
	i) FDR Interest (GPF A/C)	5,23,735.00		3,98,333.00	
	ii) FDR Interest (Pension Fund A/C)	25,29,485.00	30,53,220.00	21,28,102.00	25,26,435.00
	b) Investments - Others				
	i) FDR Interest (ST RADAR Project)	52,778.00		50,411.00	
	ii) FDR Interest (ISRO Project)	-	52,778.00	21,456.00	71,867.00
	c) Loans and Advances	48,427.00	48,427.00	-	
	d) Others (Specify):-				
	i) Interest on Project Bank A/Cs	-		-	
	ii) Interest on Saving Bank A/Cs	64,84,720.00	64,84,720.00	50,46,541.00	50,46,541.00
4	Claims Receivable	-	-	-	-
	TOTAL (B)		3,26,80,354.29		2,72,62,966.37
	TOTAL (A+B)		21,79,46,699.88		24,88,98,462.87

*As Per Separate List Attached

Annexed to the Balance Sheet of even date attached.

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS

CA. RAMA SHANKAR KAFALTIYA, FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]

PLACE : HALDWANI
DATED : September 09, 2024

R.S. KAFALTIYA & ASSOCIATES Chartered Accountants FRN:024191C HALDWANI

For and on behalf of ARIES, Nainital

(REGISTRAR) रजिस्ट्रार / Registrar आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान Aryabhatta Research Institute of Observational Sciences एरीज, मनोरा पीक, नैनीताल- 263001 ARIES, Manora Peak, Nainital- 263 001

(DIRECTOR) प्रो० दीपांकर बनर्जी / Prof. Dipankar Banerjee निदेशक / Director Aryabhatta Research Institute of Observational Sciences (ARIES) आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज) मनोरा पीक, नैनीताल-263001 / Manora Peak, Nainital-263001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st March 2024

	SCHEDULE 12 - INCOME FROM SALES/SERVICES		(Amount in "INR")
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2024 (Credit)	Previous Year For the year ended 31st March 2023 (Credit)
1	**Income from Sales**		
	a) Sale of Finished Goods	-	-
	b) Sale of Raw Material	-	-
	c) Sale of Scraps	-	5,47,458.00
2	**Income from Services**		
	a) Labour and Processing Charges	-	-
	b) Professional/ Consultancy Services	-	-
	c) Agency Commission and Brokerage	-	-
	d)Maintenance Servies (Equipment/ Property)	-	-
	e) Others (Specify)	-	-
	TOTAL	-	5,47,458.00

	SCHEDULE 13 - GRANTS/SUBSIDIES		(Amount in "INR")
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2024 (Credit)	Previous Year For the year ended 31st March 2023 (Credit)
1	**Central Government Grants:**		
	-Grant in aid "General"	14,44,00,000.00	9,43,00,000.00
	-Grant in aid "Salary"	17,48,56,025.00	17,15,00,000.00
2	State Government Grants	-	-
3	Government Agencies	-	-
4	Others (specify)	-	-
	TOTAL	31,92,56,025.00	23,31,00,000.00

Annexed to the Statement of Income & Expenditure
of even date attached herewith.

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS

CA. RAMA SHANKAR KAFALTIYA, FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]

PLACE : HALDWANI
DATED : September 09, 2024

R.S. KAFALTIYA & ASSOCIATES * HALDWANI * Chartered Accountants FRN:024191C

For and on behalf of ARIES, Nainital

(REGISTRAR) रजिस्ट्रार

(DIRECTOR)

आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
Aryabhatta Research Institute of Observational Sciences
एरीज, मनोरा पीक, नैनीताल– 263001
ARIES, Manora Peak, Nainital- 263001

प्रो दीपांकर बनर्जी / Prof. Dipankar Banerjee
निदेशक / Director
Aryabhatta Research Institute of Observational Sciences (ARIES)
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
मनोरा पीक, नैनीताल–263001 / Manora Peak, Nainital-263001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st March 2024

SCHEDULE 14 - FEES/SUBSCRIPTIONS (Amount in "INR")

S.NO	PARTICUALRS	Current Year For the year ended 31st March 2024 (Credit)	Previous Year For the year ended 31st March 2023 (Credit)
1	Entrance Fees	-	-
2	Annual Fees/ Subscriptions	-	-
3	Seminar/ Programe Fees	-	-
4	Consultancy Fees	-	-
5	Others (Specify)	-	-
	TOTAL	-	-
	Annexed to the Statement of Income & Expenditure of even date attached herewith.	-	

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS

CA. RAMA KAFALTIYA, FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]

PLACE : HALDWANI
DATED : September 09, 2024

For and on behalf of ARIES, Nainital

REGISTRAR) (DIRECTOR)

आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान प्रो॰ दीपांकर बनर्जी / Prof. Dipankar Banerjee
Aryabhatta Research Institute of Observational Sciences निदेशक / Director
एरीज, मनोरा पीक, नैनीताल-263001 Aryabhatta Research Institute of Observational Sciences (ARIES)
ARIES, Manora Peak, Nainital-263001 आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
पीक, नैनीताल-263001 / Manora Peak, Nainital-263001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st March 2024

	SCHEDULE 15 - INCOME FROM INVESTMENTS						(Amount in "INR")
S.NO	PARTICUALRS	Investment from Earmarked Fund		Investment - Others		Total	
		Current Year	Previous Year	Current Year	Previous Year	Current Year	Previous Year
		For the year ended 31st March 2024	For the year ended 31st March 2023	For the year ended 31st March 2024	For the year ended 31st March 2023	For the year ended 31st March 2024	For the year ended 31st March 2023
		(Credit)	(Credit)	(Credit)	(Credit)	(Credit)	(Credit)
1	Interest	-	-	-	-	-	-
2	Dividends:	-	-	-	-	-	-
3	Rents	-	-	-	-	-	-
4	Others (Specify)					-	-
	-Interest on FDR (GPF A/C)	10,60,052.00	9,76,964.00	-	-	10,60,052.00	9,76,964.00
	-Interest on FDR (Pension Fund A/C)	-	-	-	-	-	-
	-Interest on FDR (ISRO Project A/C)	48,711.00	-	-	57,886.00	48,711.00	57,886.00
	-Interest on FDR (ST RADAR Project)	1,34,082.00	-	-	1,19,796.00	1,34,082.00	1,19,796.00
	TOTAL	12,42,845.00	9,76,964.00	-	1,77,682.00	12,42,845.00	11,54,646.00
	TRANSFFRRED TO INVESTMENTS	12,42,845.00	9,76,964.00	-	1,77,682.00	12,42,845.00	11,54,646.00

Annexed to the Statement of Income & Expenditure
of even date attached herewith.

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS

CA. RAMA SHANKAR KAFALTIYA, FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]

R.S. KAFALTIYA & ASSOCIATES * HALDWANI * Chartered Accountants FRN:024191C

PLACE : HALDWANI
DATED : September 09, 2024

For and on behalf of ARIES, Nainital

(REGISTRAR)
रजिस्ट्रार / Registrar
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
Aryabhatta Research Institute of Observational Sciences
एरीज, मनोरा पीक, नैनीताल– 263001
ARIES, Manora Peak, Nainital-263 001

(DIRECTOR)
प्रो० दीपांकर बनर्जी / Prof. Dipankar Banerjee
निदेशक / Director
Aryabhatta Research Institute of Observational Sciences (ARIES)
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
मनोरा पीक, नैनीताल–263001 / Manora Peak, Nainital-263001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st March 2024

	SCHEDULE 16 - INCOME FROM ROYALTY, PUBLICATION ETC.			(Amount in "INR")	
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2024		Previous Year For the year ended 31st March 2023	
1	Income from Royalty	-	-	-	-
2	Income from Publications	-	-	-	-
3	Others (specify)	-	-	-	-
	TOTAL	-	-	-	-

	SCHEDULE 17 - INTEREST EARNED			(Amount in "INR")	
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2024		Previous Year For the year ended 31st March 2023	
1	On Term Deposits:				
	a) With Scheduled Banks	-		-	
	(Separately shown as Income from Investments)				
	b) With Non-Scheduled Banks	-		-	
	c) Others	-	-	-	-
2	On Savings Accounts:				
	a) With Scheduled Banks				
	-GPF A/C (SBI - 300)	3,12,122.00		5,00,890.00	
	-Pension Fund A/C (SBI - 311)	252.00		32,27,998.00	
	-Pension Fund A/C (UBI - 535)	21,031.00		20,916.00	
	-Pension Fund A/C (SBI - 535)	46,16,678.00		-	
	-Canteen Bank A/Cs	5,746.00		5,579.00	
	b) With Non-Scheduled Banks	-		-	
	c) Others	-	49,55,829.00	-	37,55,383.00
3	On Loans:				
	a) Employees/Staff				
	-HBA Interest	3,67,089.00		4,11,244.00	
	-Car Advance Interest	91,790.00		28,720.00	
	-Computer Advance Interest	72,631.00		26,984.00	
	-M.Cycle Advance Interest	4,363.00	5,35,873.00	2,500.00	4,69,448.00
	b) Others - Intt on Income Tax Refund		-		-
	TOTAL		54,91,702.00		42,24,831.00

Annexed to the Statement of Income & Expenditure
of even date attached herewith.

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS

CA. RAMA SHANKAR KAFALTIYA, FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]

PLACE : HALDWANI
DATED : September 09, 2024

R.S. KAFALTIYA & ASSOCIATES * HALDWANI * Chartered Accountants FRN.024191C

For and on behalf of ARIES, Nainital

(REGISTRAR) रजिस्ट्रार / Registrar
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
Aryabhatta Research Institute of Observational Sciences
एरीज, मनोरा पीक, नैनीताल– 263001
ARIES, Manora Peak, Nainital- 263 001

(DIRECTOR) प्रो. दीपांकर बनर्जी / Prof. Dipankar Banerjee
निदेशक / Director
Aryabhatta Research Institute of Observational Sciences (ARIES)
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
मनोरा पीक, नैनीताल–263001 / Manora Peak, Nainital-263001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st March 2024

	SCHEDULE 18 - OTHER INCOMES				(Amount in "INR")
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2024		Previous Year For the year ended 31st March 2023	
		(Credit)	(Credit)	(Credit)	(Credit)
1	Profit on Sale/disposal of Assets	-	-	-	-
2	Export Incentives realized	-	-	-	-
3	Fees for Miscellaneous Services:				
	a) Electricity Charges	4,67,942.00		4,25,842.00	
	b) Medical Contribution	8,90,450.00		11,55,600.00	
	c) Water Charges	1,81,973.00		1,47,040.00	
	d) House License Fees	6,37,855.00	21,78,220.00	3,64,570.00	20,93,052.00
4	Miscellaneous Income:				
	a) Guest House rent	625.00		6,250.00	
	b) Hostel/ shop rent	79,420.00		4,19,509.00	
	c) EMD Security Forfeited & LD	2,07,610.00		4,40,053.00	
	d) Project Overhead Charges	11,44,682.00		31,35,383.50	
	e) RTI Receipts	6,268.00		1,068.00	
	f) Canteen Receipts (Food Bill)	48,55,986.00		47,88,839.00	
	g) Electrical Penalty	-		21,954.00	
	h) Tuition Fee Recovery	2,32,000.00		1,20,000.00	
	i) Recruitment Fee	7,500.00		97,855.00	
	j) LC Extension Fee	-		13,207.00	
	k) Other Incomes	4,72,104.00		6,37,981.50	
	l) Recovery of TA Advance	-	70,06,195.00	-	96,82,100.00
	TOTAL		91,84,415.00		1,17,75,152.00

Annexed to the Statement of Income & Expenditure
of even date attached herewith.

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS

CA. RAMA SHANKAR KAFALTIYA, FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]

PLACE : HALDWANI
DATED : September 09, 2024

R.S. KAFALTIYA & ASSOCIATES * HALDWANI * Chartered Accountants FRN 024191C

For and on behalf of ARIES, Nainital

(REGISTRAR)
रजिस्ट्रार / Registrar
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
Aryabhatta Research Institute of Observational Sciences
एरीज, मनोरा पीक, नैनीताल– 263001

(DIRECTOR)
प्रो. दीपांकर बनर्जी / Prof. Dipankar Banerjee
निदेशक / Director
ARIES, Manora Peak, Nainital-263001
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
मनोरा पीक, नैनीताल–263001 / Manora Peak, Nainital-263001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st March 2024

SCHEDULE 19 - INCREASE/(DECREASE) IN INVENTORIES (Amount in "INR")

S.NO	PARTICUALRS	Current Year For the year ended 31st March 2024 (Credit)		Previous Year For the year ended 31st March 2023 (Credit)	
1	stock				
	-Finished Goods				
	-Work-in-progress				
	-Consumables	-	36,10,190.35	31, 109.00	31,78,109.00
2	Less: Opening Stock	-		-	
	-Finished Goods	36,10,190.35		78,	
	-Work-in-progress				
	-Consumables	78,109.00	31,78,109.00	54,757.40	34,54,757.40
	NET INCREASE/(	- 31,		- 34,	76,648.40)
	Annexed to the Statement of Income & Expenditure of even date attached DECREASE) [1-2]		- 4,32,081.35		(2,

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS

CA. RAMA SHANKAR KAFALTIYA, FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]

PLACE : HALDWANI
DATED : September 09, 2024

Chartered Accountants FRN:024191C
KAFALTIYA ASSOCIATES HALDWANI

For and on behalf of ARIES, Nainital

आर्यभट्ट प्रेक्षण विज्ञान
Aryabhatta Research Institute of Observational Sciences
एरीज, मनोरा पीक,
ARIES, Manora Peak,
रजिस्ट्रार / Registrar
(REGISTRAR)

बनर्जी / Banerjee
निदेशक / Director
Institute of Observational Sciences (ARIES)
विज्ञान शोध संस्थान (एरीज)
Manora Peak, Nainital-263001
Dr. Dipankar Banerjee
Director
(DIRECTOR)

शोध संस्थान
Aryabhatta Research Institute of Observational Sciences
नैनीताल-263001
Nainital-263001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31/03/2024

	SCHEDULE 20 - ESTABLISHMENT EXPENSES		(Amount in "INR")
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2024 (Debit)	Previous Year For the year ended 31st March 2023 (Debit)
1	Salaries and Wages	10,52,15,887.00	11,53,01,969.00
2	Allowances and Bonus	4,25,31,434.00	4,04,22,044.00
3	Contribution to NPS	1,22,09,249.00	1,20,86,309.00
4	Others (specify)		
	-Medical Expenses	51,23,852.00	47,26,187.00
	-Fellowship	2,62,13,082.00	2,45,02,721.00
	-Leave Encashment	62,28,268.00	-
	-Leave Travel Concession	11,02,843.00	8,40,645.00
	- Gratuity Expenses	46,45,039.00	-
	-Reimbursement of Tuition Fees	2,43,000.00	18,90,000.00
5	Prior Period Expenses		-
	-Leave Encashment (Prior Period)	54,97,517.00	-
	- Gratuity Expenses (Prior Period)	52,69,768.00	-
	TOTAL	21,42,79,939.00	19,97,69,875.00

Annexed to the Statement of Income & Expenditure
of even date attached herewith.

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS

CA. RAMA SHANKAR KAFALTIYA, FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]

PLACE : HALDWANI
DATED : September 09, 2024

R.S. KAFALTIYA & ASSOCIATES * HALDWANI * Chartered Accountants FRN:024191C

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

रजिस्ट्रार / Registrar प्रो. दीपांकर बनर्जी / Prof. Dipankar Banerjee
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान निदेशक / Director
Aryabhatta Research Institute of Observational Sciences (ARIES)
एरीज, मनोरा पीक, नैनीताल– 263001 आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
ARIES, Manora Peak, Nainital-263001 नैनीताल–263001 / Manora Peak, Nainital-263001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st March 2024

	SCHEDULE 21 - OTHER ADMINISTRATIVE EXPENSES		(Amount in "INR")
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2024 (Debit)	Previous Year For the year ended 31st March 2023 (Debit)
1	Repair & Maintenance (Minor Works)	1,51,93,219.00	32,31,879.00
2	Consumable Expenses	1,11,87,273.00	46,18,437.00
3	Other Administrative Expenses *	1,43,48,302.00	1,68,77,930.00
4	Meeting Expenses *	29,21,797.00	72,90,710.00
5	AMC Expenses	15,21,797.00	17,46,430.00
6	Prior Period Expenses	-	-
7	Travelling Expenses	89,91,407.91	63,37,587.72
8	Conveyance Expenses	25,99,495.00	26,06,308.00
9	POL (Fuel) Expenses	39,48,518.00	42,53,744.00
10	Custom Duty / Custom Clearance Charges	15,17,961.00	3,58,782.00
11	Contract Salary (UPNL)	65,51,623.00	52,69,239.00
12	Security Expenses (UPNL)	71,65,501.00	79,55,288.00
13	Electricity Expenses	85,83,823.00	76,64,699.00
14	Legal Fee / Professional Fee/ Consultance Charges	5,12,010.00	4,41,310.00
15	Library Expenses (Journals)	35,83,041.22	25,08,824.00
16	Cleaning Work Expenses	50,90,911.00	54,90,697.00
17	ASTRAD Annual License Fee	7,03,715.76	1,97,534.24
18	Workshop Expenses	3,30,418.00	5,05,444.00
19	Bank Charges	1,57,145.34	75,777.56
20	Office Expenses	2,64,369.00	13,57,527.50
21	Telephone Expenses	4,40,013.00	3,28,134.00
22	Audit Fees	60,930.00	45,000.00
23	Printing & Stationary Expenses	2,45,544.00	6,20,704.00
24	Hospitality Expenses	-	97,500.00
25	Insurance Charges	1,82,123.32	92,751.68
26	Manpower Expenses	1,00,63,441.00	88,25,799.00
27	Advertisement Expenses	7,12,702.00	45,412.00
28	Annual Report Translation Fee	-	-
29	BSNL Lease Rent	15,23,181.00	16,38,649.00
30	Dispensary Expenses	28,481.00	1,68,936.00
31	Freight & Cartage	14,634.00	14,050.00
32	Registration Expenses	3,27,059.00	69,274.00
33	Licence Fee Renewal (ILMT)	1,93,576.00	-
34	Consultancy/IISF Expo/ILMT Hiring / Training	38,23,593.00	63,939.00
	TOTAL	11,27,87,604.55	9,07,98,296.70

*As per separate list attached.

Annexed to the Statement of Income & Expenditure of even date attached herewith.

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS

CA. RAMA SHANKAR KAFALTIYA, FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]

PLACE : HALDWANI
DATED : September 09, 2024

R.S. KAFALTIYA & ASSOCIATES * HALDWANI * Chartered Accountants FRN:024191C

For and on behalf of ARIES, Nainital

प्रो० दीपांकर बनर्जी / Prof. Dipankar Banerjee
निदेशक / Director
(DIRECTOR)

रजिस्ट्रार / Registrar
(REGISTRAR)

आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान / Aryabhatta Research Institute of Observational Sciences (ARIES)
Aryabhatta Research Institute of Observational Sciences (ARIES)
एरीज, मनोरा पीक, नैनीताल-263001 / ARIES, Manora Peak, Nainital-263001
ARIES, Manora Peak, Nainital- 263 001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st March 2024

SCHEDULE 22 - EXPENDITURE ON GRANTS (Amount in "INR")

S.NO	PARTICUALRS	Current Year For the year ended 31st March 2024 (Debit)	Previous Year For the year ended 31st March 2023 (Debit)
1	Grant given to Institutions		
2	Subsidies given to Institutions	-	-
	TOTAL	-	-

SCHEDULE 23 - INTEREST EXPENDITURES (Amount in "INR")

S.NO	PARTICUALRS	Current Year For the year ended 31st March 2024 (Debit)	Previous Year For the year ended 31st March 2023 (Debit)
1	On Fixed Loans		
2	On Other Loans (including Bank Charges)		
3	Others (specify)		
	-Interest returned to DST (2019-2020)	-	-
	-Interest payable to DST (2020-2021)	-	-
	-Interest accrued on GPF A/C	37,38,096.00	39,13,289.00
	- Interest - TDS	-	-
	TOTAL	37,38,096.00	39,13,289.00
	Annexed to the Statement of Income & Expenditure of even date attached herewith.	-	-

For R.S.KAFALTIYA & ASSOCIATES

For and on behalf of ARIES, Nainital

FCA

PROPRIETOR
CHARTERED ACCOUNTANTS
[FRN - 024191C]
[MRN - 411796]
CA. RAMA SHANKAR KAFALTIYA,
PLACE : HALDWANI
DATED : September 09, 2024

STRAR) (DIRECTOR)

Manora Peak, Nainital-263001
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान / Prof. Dipankar Banerjee
Aryabhatta Research Institute of Observational Sciences / निदेशक / Director
एरीज, मनोरा पीक, नैनीताल-263001 Institute of Observational Sciences (ARIES)
ARIES, Manora Peak, Nainital-263001 विज्ञान शोध संस्थान (एरीज)

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

ANNEXURE OF SCH 11(A)(4): LIST OF BANK ACCOUNTS AS ON 31.03.2024

(Amount in "INR")

S. NO.	PARTICULARS	Current Year For the year ended 31st March 2024 Debit	Previous Year For the year ended 31st March 2023 Debit
1	Director's (SBI) Bank A/C 10860840253	8,44,42,752.74	8,91,20,177.21
2	Director's RBI Director Account No. 10695601013	-	3,39,21,054.00
2	GPF (SBI) A/C 10860840300	1,26,87,536.30	1,25,69,647.30
3	SBI (Canteen) Bank A/C 32320085086	2,15,851.99	2,10,107.99
4	SBI (Staff Welfare Fund) Bank A/C - 39589660093	3,80,009.00	2,98,530.00
5	LC Account No 00000041084215005	39,00,032.00	37,00,000.00
6	Pension Fund A/Cs:		
	Pension Fund (SBI) A/C - 10860840311	7,17,87,942.70	6,80,34,063.70
	Pension Fund (UBI) A/C - 534702010000535	7,78,006.02	7,56,975.02
	Total (6)	7,25,65,948.72	6,87,91,038.72
7	Project Bank A/Cs		
	SBI (ISRO-GBP-ARFI) Bank A/C 30192927780	1,309.00	5,99,181.00
	SBI (ISRO ATCTM Project) Bank A/C 30310168038	7,82,645.54	48,08,149.54
	SBI (ISRO-GBP-ABLN & C) Bank A/C 30318931302	21,82,580.00	17,46,523.00
	SBI (ST RADAR Project) Bank A/C 30357703902	22,73,139.00	22,12,661.00
	SBI (Thai Project) Bank A/C 38832273131	94,363.50	1,08,445.50
	UCO (UCOST Project) BANK A/C 28720110011577	78.45	4,140.45
	UBI (SRG/SERB/2021 Project) A/C - 534702010004272	-	0.79
	SBI (Project A/c) 00000040993525190	7,714.50	39,725.50
	SBI (Project A/c)41079416912	25,125.50	3,17,277.50
	SBI Bank A/c SERB/SRS/113 42557691842	6,15,894.00	-
	SBI Project A/c (42482471194)	4,43,755.00	-
	SBI Project A/c (42719584862)	9,60,107.00	-
	SBI SERB NPDF Account No. 42482475892	77,313.00	-
	Total (7)	74,64,024.49	98,36,104.28
	Grand Total (1+2+3+4+5+6)	18,16,56,155.24	21,84,46,659.50

Annexed to Sch 12(A)(4) of the Balance Sheet of even date attached.

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS

CA. RAMA SHANKAR KAFALTIYA, FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]

PLACE : HALDWANI
DATED : September 09, 2024

R.S. KAFALTIYA & ASSOCIATES * HALDWANI * Chartered Accountants FRN:024191C

For and on behalf of ARIES,
Nainital

(REGISTRAR)

प्रो० दीपांकर बनर्जी / Prof. Dipankar Banerjee
निदेशक / Director
(DIRECTOR)

आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
Aryabhatta Research Institute of Observational Sciences (ARIES)
एरीज, मनोरा पीक, नैनीताल– 263001
ARIES, Manora Peak, Nainital- 263 001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

ANNEXURE OF SCH 7: LIST OF OUTSTANDING EXPENSES AS ON 31.03.2024

Sl.No	PARTICULARS	For the year ended 31st March 2024
1	Secu	5,61,325.00
2	Security Expenses (UPNL)	6,72,523.00
3	Manpower Expenses (Aryan rity Services)	2,83,743.00
4	Canteen Expenses	10,68,585.00
5	NPS Contribution	2,092.00
6	NSDL Maintenance charges	77,802.00
7	Internet Employer	5,23,317.00
8	Contractual Salary (UPNL)	64,51,800.00
9	ries Expenses (Amazon)	32,25,800.00
10	DA	2,64,906.00
11	Pay/sala	2,33,550.00
12	Transport Allowance	1,16,775.00
13	DA on TA	170.00
14	HRA	1,22,799.00
15	Extra work allowance	23,73,233.00
16	Contract employee salary	5,34,758.00
17	Pension expenses	26,60,419.00
18	DA Arrear	45,000.00
	Fel	1,92,18,597.00
	Audit	
	Township Expenses	

Annexed to Sch 7 of the Balance Sheet of even date attached.

For R.S.KAFALTIYA & ASSOCIATES

CA. SHAN KAFALTIYA, FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]

PLACE : HALDWANI
DATED : September 09, 2024

CHARTERED ACCOUNTANTS
RAMA KAR
Chartered Accountants FRN:024191
R.S. KAFALTIYA & ASSOCIATES * HALDWANI *

For and on behalf of ARIES, Nainital

(DIRECTOR)
दीपांकर बनर्जी / Prof. Dipankar Banerjee
निदेशक / Director
ARIES)
63001

(REGISTRAR)
राजस्ट्रार / Registrar
संस्थानी०

आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
Aryabhatta Research Institute of Observational Sciences (ARIES)
एरीज, मनोरा पीक, नैनीताल-263001 / ARIES, Manora Peak, Nainital-263001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

ANNEXURE OF SCH-7 (7) (m): LIST OF EXTRANEOUS CREDITS FOR THE YEAR ENDED 31.03.2024

Date	Relevant Head of Account	Particular	Current Year	Previous Year
			For the year ended 31st March 2024	For the year ended 31st March 2023
19/11/2022	Sbi Sb0000004077890848S Inspire Faculty	Difference in Opening Balance of Bank Account As On 01-04-2022	0	16,47,308.00
30/03/2023	SBI (Director) Bank A/C - 10860840253	Amount Received From Rajesh Madukar Raou Reason Of Collection is not known	16923	16,923.00
31/03/2023	Sbi Project A/c 40540652714	Difference in Opening Balance As On 01-04-2022 Not Recorded In Tally Transferred To Ext Credit Account	-	4,21,760.00
31/03/2023	SBI (Director) Bank A/C - 10860840253	Difference in Closing Balance of director bank account 253 and associated MODs as per books of accounts of ARIES and Bank Statement. Balances as per bank statement are Account253- 2,14,55,827 and MOD accounts- 6,76,64,350.21 i.e. 8,91,20,177.20 whereas Balane Of these bank accounts as per books of accounts of ARIES is 8,77,38,008.51 (Including MOD)	1382168.7	13,82,168.70
13/06/2023	SBI (Director) Bank A/C - 10860840253	Being amount received from Science and Engineering Board (TRANSFER NEFT* RBISOPFMS01 *RBI16S2310584961 *Science and Engi-) FROM 4697218044300	49528	0.00
29/09/2023	SBI (Director) Bank A/C - 10860840253	Being TRANSFER NEFT* UBIN0566420*001063806210 *BILLS PAYABLE - OTHE Transfer from 4697186044303	37500	0.00
31/03/2024	RBI Director account 1013	Amount received in bank account not recorded in books of accounts (F.Y. 2023-24)	777695	0.00
31/03/2024	Bank of Maharastra-5293	Excess remittance to DST in Inspire Projects (Ayushi & Tushar)	33293	0.00
31/03/2024	SBI Bank account 27780	Excess remittance to DST in ISRO-GBP-ARFI Project	91654	0.00
		Total	23,88,761.70	34,68,159.70

Annexed to Schedule 7 (7) (m) of the Balance Sheet

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

ANNEXURE OF SCH-11 (b) (2) (c): LIST OF EXTRANEOUS DEBITS FOR THE YEAR ENDED 31.03.2024

Date	Relevant Head of Account	Particular	Current Year	Previous Year
			For the year ended 31st March 2024	For the year ended 31st March 2023
23/09/2022	SBI (Director) Bank A/C - 10860840253	Interest earned on ILTP Project account no. 31286509555 was transferred to Bharatkosh. The amount was not shown in opening balance as outstanding payment.	48,812.00	48,812.00
12/12/2022	SBI (EMR-2016-1723 Project) Bank A/C - 37039717963	Amount received from Karan, Argan Ghosh, Devanand and Bibhuti Kumar Jha on account of excess payment towards TA bill not deposited in bank account	0.00	29,877.00
31/03/2023	SBI Project Bank A/C - 372665312845	Difference in opening balance of bank account as on 01-04-2022	0.00	20,63,925.00
31/03/2024	Bank of Maharastra-5293 account	Amount paid for project handling charges from bank of maharastra-5293 bank account	0.00	0.00
31/03/2024	RBI Director account 1013	Amount paid to various parties not recorded in books (F.Y. 2022-23)	3,43,109.00	0.00
		Total	3,91,921.00	21,42,614.00

Annexed to Schedule SCH-11 (b) (2) (c) of the Balance Sheet

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS

CA. RAMA SHANKAR KAFALTIYA FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]

PLACE : HALDWANI
DATED : September 09, 2024

R.S. KAFALTIYA & ASSOCIATES * HALDWANI * Chartered Accountants FRN:024191C

For and on behalf of ARIES, Nainital

(REGISTRAR) रजिस्ट्रार / Registrar
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
Aryabhatta Research Institute of Observational Sciences
एरीज, मनोरा पीक, नैनीताल– 263001
ARIES, Manora Peak, Nainital- 263001

(DIRECTOR)
प्रो. दीपांकर बनर्जी / Prof. Dipankar Banerjee
निदेशक / Director
Aryabhatta Research Institute of Observational Sciences (ARIES)
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
मनोरा पीक, नैनीताल-263001 / Manora Peak, Nainital-263001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL

ANNEXURE OF SCH-21 (3): LIST OF OTHER ADMINISTRATIVE EXPENSE FOR THE YEAR ENDED 31.03.2024

S. NO.	PARTICULARS	Current Year For the year ended 31st March 2024	Previous Year For the year ended 31st March 2023
		DEBIT	DEBIT
1	Canteen Expenses	1,02,94,482.00	1,04,08,363.00
2	Water Expenses	9,43,755.00	12,23,210.00
3	Pest Control Expenses	1,59,576.00	31,270.00
4	Internet Charges	10,81,776.00	15,82,667.00
5	Wages	6,12,138.00	5,20,848.00
6	Return Filing Fees - GST/TDS	1,62,750.00	2,68,673.00
7	NPS Service Charges	5,531.00	12,698.00
8	Gardening Expenses	-	1,32,916.00
9	Guest House Expenses	60,758.00	1,72,241.00
10	Academic Expenses	4,92,538.00	4,12,000.00
11	Labour / Service Charges	-	70,894.00
12	Laundry Expenses	29,297.00	35,395.00
13	Ph. D. Registration Expenses	4,63,760.00	9,69,008.00
14	Internship Expenses	0.00	9,20,400.00
15	Postage Expenses	21,040.00	66,813.00
16	ARIES-IIA-AWSAR Prize	-	16,000.00
17	LC Opening/extension Charges	11,011.00	34,534.00
18	Internship expenses	10,000.00	-
19	Services Charges	(110.00)	-
	Total	1,43,48,302.00	1,68,77,930.00

Annexed to Schedule 21 (3) of the Statement of Income & Expenditure of even date attached.

ANNEXURE OF SCH 21 (4): LIST OF MEETING EXPENSES FOR THE YEAR ENDED 31.03.2024

S. NO.	PARTICULARS	Current Year For the year ended 31st March 2024	Previous Year For the year ended 31st March 2023
		DEBIT	DEBIT
1	ATSOA 2020 Meeting Expenses	58,171.00	44,122.00
2	Hindi Program Expenses	4,58,118.00	2,00,950.00
3	Public Outreach Programme	6,67,809.00	7,56,146.00
4	Scientific Meeting Expenses	13,37,699.00	62,89,492.00
5	ASI-2020 Meeting Expenses	4,00,000.00	-
	Total	29,21,797.00	72,90,710.00

Annexed to Schedule 21 (4) of the Statement of Income & Expenditure of even date attached.

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS

CA. RAMA SHANKAR KAFALTIYA, FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411796]

PLACE : HALDWANI
DATED : September 09, 2024

R.S. KAFALTIYA & ASSOCIATES Chartered Accountants FRN:024191C HALDWANI

For and on behalf of ARIES, Nainital

(REGISTRAR) रजिस्ट्रार / Registrar
(DIRECTOR) प्रो० दीपांकर बनर्जी / Prof. Dipankar Banerjee निदेशक / Director
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
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ARIES, Manora Peak, Nainital-263001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL
STATEMENT OF RECEIPT AND PAYMENT FOR THE YEAR ENDED 31st MARCH, 2024

S.No	RECEIPTS	Current Year 2023-2024	Current Year 2023-2024		PAYMENTS	Current Year 2023-2024	Current Year 2023-2024
I	Opening Balances:			I	Fixed Assets		
	a) Bank Balances	21,84,46,659.50			Buildings	97,99,847.00	
	b) Cash-in Hand	10,728.00	21,84,57,387.50		Capital Work-in-Progress	4,99,05,820.00	
II	Capital Account				Computers / Peripherals	70,64,652.00	
	Capital Fund		17,17,00,000.00		Electric Installations	1,33,71,939.00	
III	Non-current Liabilities				Furniture & Fixtures	38,90,155.00	
	Staff Welfare Fund	1,43,338.00			Library Books	1,03,388.00	
	Earmarked / Endowment Funds	54,41,159.00	55,84,497.00		Office Equipments	33,04,851.00	
					Other Fixed Assets	94,30,349.00	
IV	Current Liabilities				Plants Machineries & Equipments	8,67,55,491.00	18,36,27,492.00
	Current Liabilities & Provisions	3,05,74,164.00		II	Current Assets		
	Statutory Liabilities	2,32,34,351.00	5,38,08,515.00		Loans and Advances	84,58,669.00	
V	Investment				Other Current Assets	23,79,241.00	1,08,37,910.00
	Investment-Others		13,86,102.00	III	Current Liabilities		
VI	Current Assets				Current Liabilities & Provisions	38,69,164.00	
	Loans and Advances	52,88,419.00			Statutory Liabilities	3,24,11,443.00	3,62,80,607.00
	Accrued Interest received		52,88,419.00	IV	Capital Account		
					Capital Fund		3,42,64,163.00
VII	Indirect Incomes			V	Non-current Liabilities		
	Grants/ Subsidies	32,02,00,000.00			Project Funds	1,44,50,378.79	
	Interest	88,61,805.00			Staff Welfare Fund	61,859.00	
	Other Incomes	80,52,515.00	33,71,14,320.00		Earmarked / Endowment Funds	1,79,67,670.00	3,24,79,907.79
VIII	Indirect Expenses (Recovery)			VI	Indirect Expenses		
	Establishment Expenses	7,15,831.00			Establishment Expenses	20,23,00,059.00	
	Other Administrative Expenses	2,27,782.00	9,43,613.00		Other Administrative Expenses	11,18,79,802.47	31,41,79,861.47
				VI	Indirect Income		
					Grants/ Subsidies	9,43,975.00	
					Other Incomes	12,782.00	9,56,757.00
				VII	Closing Balance		
					a) Bank Balances	18,16,56,155.24	
					b) Cash-in Hand (Imprest)	-	18,16,56,155.24
	Total		79,42,82,853.50		Total		79,42,82,853.50

As per our separate Audit Report of even date attached.

For R.S.KAFALTIYA & ASSOCIATES
CHARTERED ACCOUNTANTS
CA. RAMA SHANKAR KAFALTIYA, FCA
PROPRIETOR
[FRN - 024191C]
[MRN - 411756]

PLACE : HALDWANI
DATED : September 09, 2024

R.S. KAFALTIYA & ASSOCIATES * HALDWANI * Chartered Accountants FRN:024191C

For and on behalf of ARIES, Nainital

(REGISTRAR)
रजिस्ट्रार / Registrar
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
Aryabhatta Research Institute of Observational Sciences
एरीज, मनोरा पीक, नैनीताल– 263001
ARIES, Manora Peak, Nainital- 263 001

(DIRECTOR)
D. Banerjee
प्रो० दीपांकर बनर्जी / Prof. Dipankar Banerjee
निदेशक / Director
Aryabhatta Research Institute of Observational Sciences (ARIES)
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
मनोरा पीक, नैनीताल–263001 / Manora Peak, Nainital-263001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCE (ARIES)

MANORA PEAK, NAINITAL

SCHEDULES FORMING PART OF THE ACCOUNTS FOR THE YEAR ENDEN 31ST MARCH 2024

SCHEDULE 24 – SIGNIFICANT ACCOUNTING POLICIES:

1. ACCOUNTING CONVENTION & ACCOUNTING POLICIES:

(a) The financial statements are prepared on the basis of historical cost convention, unless otherwise stated, and on the basis of ACCRUAL method of accounting except for the following: -

(i) Transaction related to re-imbursement of telephone expenses to employees are recorded in the books of account on cash basis as there is no mechanism to determine the cost of these expenses and the payment is made as and when the claims are submitted by the employees in this regard;

(ii) Transaction related to GST – TDS are recorded in the books of accounts on cash basis;

(iii) Transaction related to interest on all the Project Bank accounts are recorded in the books of accounts on cash basis; and

(iv) Transaction related to all legal expenses related to court cases are recorded in the books of accounts on cash basis.

2. INVENTORY VALUATION:

a) As the Institute is engaged in research activities only and is not engaged in any manufacturing, trading and/or business activities, it does not carry any inventory of finished goods, raw materials etc.

b) Inventories of the Institute consists "Consumable items" only and includes the stock of Stores & Spares, Fuel, Stationery, Computer Accessories and Postage Stamps.

c) Inventories are valued at Cost as per Accounting Policy of the Institute.

d) List of inventories is prepared on the basis of records maintained by the purchase and issue department of the Institute. The inventory is in good condition and is fully usable.

e) All inventories owned by the Institute, wherever located, have been recorded.

f) The physical verification of the Inventory of the Institute as on 31st March 2024 has been completed and recorded in the office record.

3. INVESTMENTS:

a) Investments of the Institute consists Fixed Deposits in Scheduled Bank only. Amount of Provident fund, STRADAR Project Fund and ISRO Project Fund are deposited in Fixed Deposit Schemes of Scheduled Bank and are shown as Investments in the Balance Sheet.

b) These Investments are valued at cost as per Institute's accounting policy.

आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
Aryabhatta Research Institute of Observational Sciences
एरीज, मनोरा पीक, नैनीताल– 263001

R. KAFALTIYA & ASSOCIATES
Chartered Accountants
FRN: 024191C
HALDWANI

प्रो० दीपांकर बनर्जी / Prof. Dipankar Banerjee
निदेशक / Director
Aryabhatta Research Institute of Observational Sciences (ARIES)
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
मनोरा पीक, नैनीताल–263001 / Manora Peak, Nainital-263001

c) All the investments, shown in the Balance Sheet, belong to the Institute and they do not include any investments held on behalf of any other persons.
d) The Institute has clear title to all of its investments. There are no charges against the investments of the Institute except those appearing in the records of the Institute.

4. PROPERTY, PLANT & EQUIPMENT:

The net book values of Property, Plant & Equipment, at which these are stated in the Balance Sheet of the Institute, are arrived at: -

a) After taking into account all capital expenditure, as additions thereto, but no expenditure being chargeable to revenue;
b) After eliminating the cost and accumulated depreciation relating to items sold, discarded, demolished or destroyed;
c) After providing adequate depreciation as per income Tax Act, 1961 on all the Property, Plant & Equipment of the Institute as the year-end;
d) After taking into account all capital work-in-progress on completion of the related work; and
e) After making necessary adjustments to present a true and fair view of Property, Plant & Equipment.

5. DEPRECIATION:

a) Depreciation is provided on **"Written Down Value"** method as per rates specifies in the Income-tax Act, 1961 except depreciation on cost adjustments arising on account of conversion of foreign currency liabilities for acquisition of fixed assets, which is amortized over the residual life of the respective assets.
b) In respect of additions to/deduction from fixed assets during the year, depreciation is considered as per income tax rules and not on pro-rata basis.

6. MISCELLANEOUS EXPENDITURE:

The Institute has the policy to write-off the Deferred Revenue Expenditure over a period of 5 year from the year it is incurred.

7. GOVERNMENT GRANTS/SUBSIDIES:

a) Institutes gets Grants from Central Government to meet out its all financial costs and to complete some related projects.
b) Institute gets Government grants to meet out Capital Expenses, Establishment Expenses, General Expenses and to complete some relevant Projects.
c) Government grants received to meet out Capital Expenditure are treated as Capital Fund and all the expenditures of capital nature are meet out from this fund.
d) Government grants received for revenue Expenditure e. g. Establishment Expenses and General Expenditure are used to meet out these expenses and the balance of the Grant (Surplus/Deficit) is transferred to Reserves & Surplus A/C.
e) Government grants/subsidies are accounted for on realization basis.

8. FOREIGN CURRENCY TRANSACTION

रजिस्ट्रार / Registrar
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
Aryabhatta Research Institute of Observational Sciences
मनोरा पीक, नैनीताल– 263001
ARIES, Manora Peak, Nainital- 263 001

R. KAFALTIYA & ASSOCIATES * HALDWANI * Chartered Accountants FRN:024191C

प्रो दीपांकर बनर्जी / Prof. Dipankar Banerjee
निदेशक / Director
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आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
मनोरा पीक, नैनीताल–263001 / Manora Peak, Nainital-263001

a) Transaction denominated in foreign currency are accounted at the exchange rate prevailing at the date of the transaction.
b) Current asset, foreign currency loans and current liabilities are converted at the exchange rate prevailing as at the year end and the resultant gain/loss is adjusted to cost of fixed assets, if the foreign currency liability relates to fixed assets, and in other cases is considered to revenue.

9. GENERAL PROVIDENT FUND:

GPF Rules are applicable to those employees of the Institute who were appointed before 1st January, 2004. As per the GPF Rules, a minimum subscription of 6% of emolument is deducted from monthly salary of the incumbents. There is no employer contribution in this scheme, it is treated as non-contributory pension scheme of Government applicable for the incumbents appointed prior to 01.01.2004.

A Fund named GPF having the accumulated balance of aforesaid subscription and interest earned thereon at the applicable rates, determined by the Government from time to time, is maintained by a committee of the Institute who keep appropriate records in this regard. The amount of the said Fund is kept in a scheduled bank.

10. NPS (EMPLOYER AND EMPLOYEE SHARE):

ARIES, Nainital is an autonomous institute under Department of Science and Technology and fully funded by the Govt. of India and follow the Govt. norms regarding retirement benefits. New Pension Scheme (NPS) introduced by the Govt. has been adopted by this institute with the approval of competent authority for those employees who was appointed after 01-01-2004. In this scheme, the employee subscription @ 10% of basis + D.A. was deducted and 10% of employer contribution was contributed till 31st March 2019. The Govt. enhance employer contribution from 10% to 14% vide O.M. No. 1/3/2016-PR dated 31st January, 2019 extended for Autonomous bodies vide Department of expenditure, Ministry of Finance, Govt. of India OM No. F. No. 1(3)/EV/2020 dated 26th August, 2021. ARIES has also implemented the revised scheme of enhanced employer contribution w. e. f. 1st April 2019 onwards.

11. RETIREMENT BENEFITS:

a. Liability towards gratuity payable on death/retirement of employees is paid as per Govt. norm at the time of retirement.
b. Accumulated leave encashment benefits to the employees are paid as per Govt. norms at the time of retirement.

12. LEASE:

Lease rentals are expensed with reference to lease terms.

PLACE: ARIES, NAINITAL
DATED: September 9 ,2024

R S KAFALTIA & ASSOCIATES Chartered Accountants FRN: 024191C HALDWANI

REGISTRAR,
ARIES, NAINITAL
रजिस्ट्रार / Registrar
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
Aryabhatta Research Institute of Observational Sciences
एरीज, मनोरा पीक, नैनीताल- 263001
ARIES, Manora Peak, Nainital- 263 001

DIRECTOR,
ARIES, NAINITAL
प्रो० दीपांकर बनर्जी / Prof. Dipankar Banerjee
निदेशक / Director
Aryabhatta Research Institute of Observational Sciences (ARIES)
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
मनोरा पीक, नैनीताल-263001 / Manora Peak, Nainital-263001

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCE (ARIES)

MANORA PEAK, NAINITAL

SCHEDULES FORMING PART OF THE ACCOUNTS FOR THE YEAR ENDED 31ST MARCH 2024

SCHEDULE 25 – CONTINGENT LIABILITIES AND NOTES ON ACCOUNT:

Sl. No	Particulars	Current Year (INR)	Previous Year (INR)
1	**CONTINGENT LIABILITIES:**		
1.1	Claims against the Institute not acknowledged as debts	1,05,65,018.00	NIL
1.2	In respect of:-		
	Bank guarantees given by/on behalf of the Entity	NIL	NIL
	Letters of Credit opened by Bank on behalf of the Entity	NIL	NIL
	Bills discounted with Banks	NIL	NIL
1.3	Disputed demands in respect of:		
	Income Tax	10,17,36,510.00	10,17,36,510.00
	Sales Tax/VAT/GST	NIL	NIL
	Municipal Taxes	NIL	NIL
2	**CAPITAL COMMITMENTS:**		
	Estimated value of contracts remaining to be executed on capital account and not provided for (Net of advances)	NIL	NIL
3	**LEASE OBLIGATION:**		
	Future obligations for rentals (finance lease arrangement)	NIL	NIL
	Arrangement for plant and machinery	NIL	NIL

4. CURRENT ASSETS, LOANS AND ADVANCE:

In the opinion of the Management, the current assets, loans and advances have a value, on realization in the ordinary course of business, equal at least to the aggregate amount shown in the Balance Sheet.

5. TAXATION:

In view the fact that the income of the Institute is exempt u/s 12 of the Income Tax Act 1961 and thus there being no taxable income under Income - tax Act 1961 for the financial year 2023-2024, the provision for Income tax is not considered necessary and thus has been made as on 31st March 2024.

रजिस्ट्रार / Registrar
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
Aryabhatta Research Institute of Observational Science
एरीज, मनोरा पीक, नैनीताल– 263001
Manora Peak, Nainital- 263 001

R S KAFALTIYA & ASSOCIATES * HALDWANI * Chartered Accountants FRN:024191C

D. Banerjee
प्रो॰ दीपांकर बनर्जी / Prof. Dipankar Banerjee
निदेशक / Director
Aryabhatta Research Institute of Observational Sciences (ARIES)
आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान (एरीज)
मनोरा पीक, नैनीताल–263001 / Manora Peak, Nainital-263001

Sl. No	Particulars	Current year (INR)	Previous Year (INR)
6.	**FOREIGN CURRENCY TRANSACTION:**		
6.1	**Value of Imported Calculated on C.I.F. basis**		
a	Purchase of Finished Goods	NIL	NIL
b	Raw Material & Components (Including in transit)	NIL	NIL
i	Capital Goods	NIL	NIL
ii	Stores, Spares and Consumables	36,00,151.35	14,54,481.00
6.2	**Expenditure in Foreign Currency:**		
a	Travel	NIL	NIL
b	Remittances and Interest payments	NIL	NIL
c	Royalty	NIL	NIL
d	Know-How Expenses	NIL	NIL
e	Professional Consultancy Fee	NIL	NIL
f	Other Expenditure:		
	Commission on Sales	NIL	NIL
	Legal and Professional Expenses	NIL	NIL
	Miscellaneous Expenses	NIL	NIL
6.3	Earnings:	NIL	NIL
	Value of Exports on FOB basis	NIL	NIL
7.	**PAYMENT TO AUDITORS:**		
a	**As Statutory Auditors**	45,000.00	45,000.00
B	As advisor or in other capacity in respect of:		
	(i) Taxation Matters	NIL	NIL
	(ii) Management Services	NIL	NIL
	(iii) Certification	NIL	NIL
C	Any other matter	NIL	NIL
8	Contingent Liabilities not provided for	1,05,65,018.00	NIL

9. Corresponding figures for the previous year have been regrouped/ rearranged, wherever necessary.

10. Schedules 1 to 25 are annexed to and form an integral part of the Balance Sheet as at 31st March 2024 and the Income and Expenditure Account for the year ended on that date.

PLACE: ARIES, NAINITAL
DATED: September 9,2024

REGISTRAR,
ARIES, NAINITAL

आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान
Aryabhatta Research Institute of Observational Sciences
एरीज, मनोरा पीक, नैनीताल- 263001
ARIES, Manora Peak, Nainital-263 001

DIRECTOR,
ARIES, NAINITAL

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