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DEPARTMENT OF SCIENCE & TECHNOLOGY

Annual Report 2020-2021

आर्यभट्ट प्रेक्षण विज्ञान शोध संस्थान

Aryabhatta Research Institute of Observational Sciences

(An Autonomous Institute under DST, Ministry of Sci. & Tech., Govt. of India)

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES

(An Autonomous Institute under DST, Ministry of Sci. & Tech., Govt. of India)

Manora Peak, Nainital - 263 001, India

ANNUAL REPORT

2020 - 2021

(1 April, 2020 to 31 March, 2021)

ARIES, Annual Report: 2020 - 2021
No. 17, 131 pages

Editor: Dr. Kuntal Misra
Associate Editor: Dr. Virendra Yadav

Editorial Assistance: Mr. Arjun Singh
Mr. Prashant Kumar

Phone	:	+91 (5942) 270700
EPABX	:	+91 (5942) 233727, 233734, 233735, 232655
Fax	:	+91 (5942) 233439
E-mail	:	krc@aries.res.in
URL	:	http://www.aries.res.in/

2020-2021

Front Cover: Highlight of solar eclipse (June, 2020) and deep sky astrophotography.
(image courtesy: Dr. Avinash Singh and Mr. Bibhuti K. Jha).
(cover designed by Ms. Shilpa Sarkar)

Back Cover: Digital art of 3.6m Devasthal Optical Telescope (DOT).
(designed by Ms. Priyanka Jalan)

September, 2021

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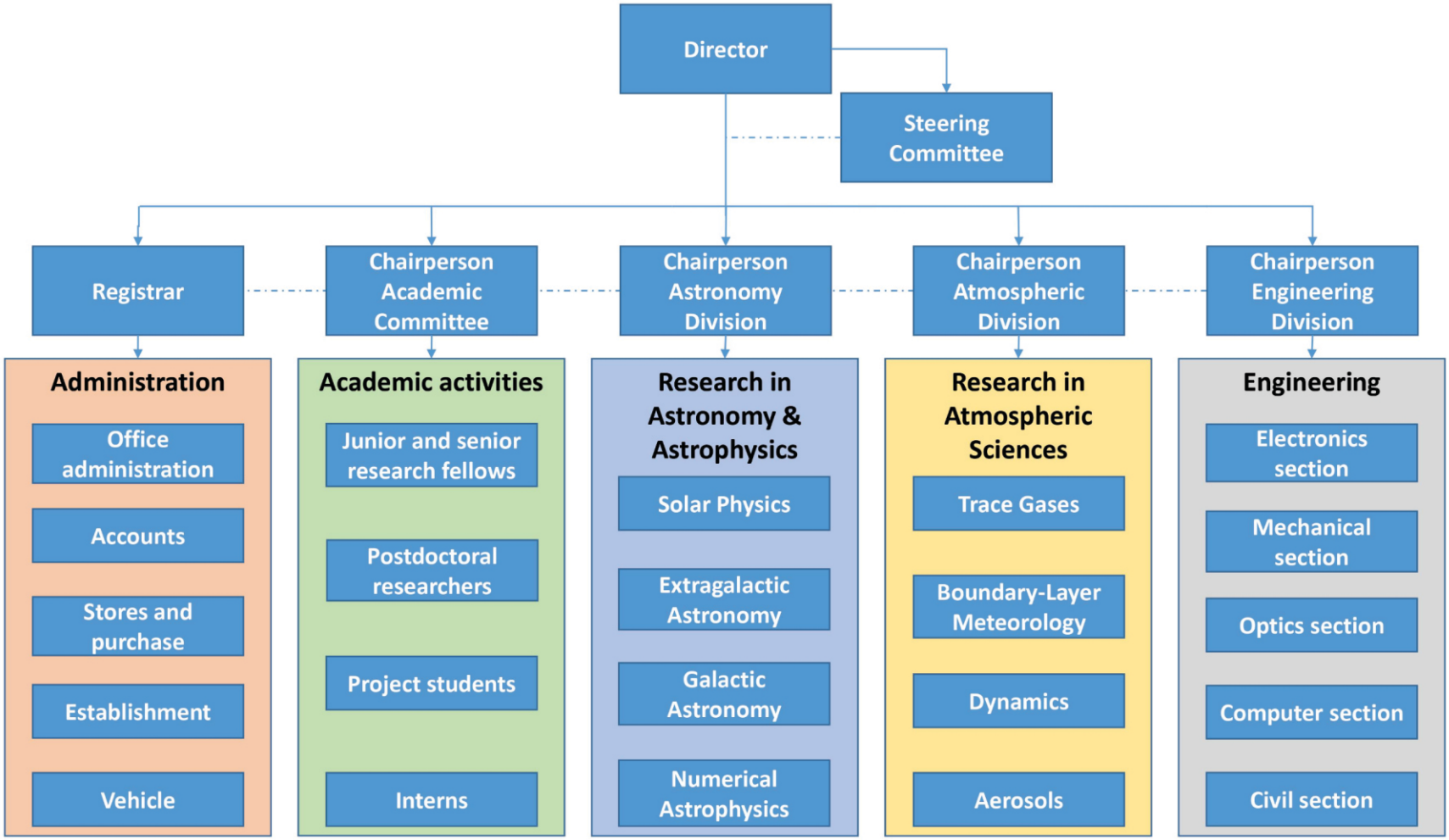

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The Year in Review

All our work and efforts were made possible because of the generosity of those who gave time, wisdom and funding in support of a shared and bold ambition to improve our capabilities, facilities and to serve our society at large. This pandemic year has been a testing time for all of us. I must thank all my colleagues at ARIES, DST and other institutions who have contributed significantly to achieve some of the targets which we set at the beginning of the year. In this report, I will highlight some of our achievements.

At ARIES we have three core divisions - Astronomy and Astrophysics (specialising primarily in observational and theoretical studies of celestial objects); Atmospheric Sciences (specialising in understanding the physical, chemical and dynamical processes governing the Earth's atmosphere); and Engineering (catering to the design, development, maintenance and upgradation of the instruments and support facilities).

ARIES have established a world class astronomical site at Devasthal, Uttarakhand where most of the major observational facilities, 1.3m Devasthal Fast Optical Telescope (DFOT), 3.6m Devasthal Optical Telescope (DOT) and 4.0m International Liquid Mirror Telescope (ILMT), are located. DFOT and DOT are fully functional and ILMT is expected to achieve first light in early 2022. The main campus of ARIES hosts one of the oldest operational telescopes - the 1.04m Sampurnanand Telescope (ST).

The 3.6m DOT is India's largest telescope operating in optical and near-infrared bands. The observing time on DOT is allotted based on the scientific merit of the proposal between astronomers working in Indian institutions/universities, astronomers from ARIES and Belgium astronomers. Since October 2020, DOT has been released for scientific observations (Cycle 2020C2 and Cycle2021C1) to the National and Belgian astronomy community. At present four backend instruments for imaging and spectroscopic observations are available. During engineering nights several telescope and instrument verification tests were performed. Some of the data acquired during the successful runs of the two observing cycles and other previous cycles have resulted in scientific publications in international journals of high impact. A press release by PIB has narrated India's achievements in Science and Technology with a special mention of the 3.6m DOT. One of the backend instrument ARIES Devasthal Faint Object Spectrograph & Camera (*AD-FOSC*) received special media attention due to its indigenous design, development by ARIES team, and the low-cost.

High cadence photometric and spectroscopic data, availing the strategic location of ARIES telescopes, have permitted for a detailed characterisation of explosive transients such as Gamma Ray Bursts (GRBs) and Supernovae (SNe) and hence determination of the plausible progenitors giving rise to such explosions, explosion scenarios and explosion properties. Several such transients were regularly monitored with ARIES facilities supplemented with data from various national and international teams. This resulted in high impact results and establishing time domain astronomy as one of the primary research areas in ARIES. Radio and optical observations have traced the mystery behind dwarf galaxy aberrations of massive star formation. One of the strongest flares, from a feeding supermassive black hole or blazar located some 10 million light years away, was observed and reported by a team of researchers at ARIES. The theoretical and numerical simulations group published results to estimate the black hole mass using a new formula to access spectra of accretion discs around black holes. The physical conditions and star formation processes in Galactic HII regions were probed using multi-wavelength observations from both ground and space

based facilities. The ARIES Imaging Polarimeter (AIMPOL) mounted on the 1.04m ST was being used for polarisation studies of different sources such as stars, open clusters, supernovae etc. Long term observations of open clusters have also resulted in discovering several new variable stars.

Long term variations on the Sun, occurring on larger time scales, are significant from the climate's point of view having a long term effect on our planet and heliosphere. Several long term studies using a century old digitised films and photographs that were taken at the Kodaikanal Solar Observatory (KoSO) of IIA, Bengaluru were undertaken. One such study developed an automatic technique to track the sunspots and measure the solar differential rotation. Solar physicists developed an algorithm to detect accelerated coronal mass ejections (CMEs) in the solar atmosphere which will be quite useful for the future space missions (*Aditya-L1*, *PROBA-3*, etc.) probing the kinematics of CMEs in the less explored region of the solar corona.

ARIES successfully operates the Stratosphere Troposphere Radar (ASTRAD) which has been designed and developed within India. Extensive scientific observations were made using ASTRAD followed by rigorous validations, including several phases of different combinations of the total 12 clusters. ASTRAD has shown the capability of making observations up to about 31 km with a clear demarcation of the tropopause. A GUI based software for offline data analysis has been developed by the team. The ST Radar facility at ARIES received a special mention under "*Science for a Self-Reliant India*" highlighting the indigenously designed facility within the country and its usefulness in disaster management. ARIES joined hands in a collaborative program of five ST-MST radars in India to perform simultaneous observations and conduct training programmes.

Observations from ASTRAD were utilized for the first ever estimation of turbulence parameters from the complex terrain region of central Himalayas, which are higher by 1 order of magnitude than those reported from the southern part of India. First estimation of vertical distributions of ozone using *INSAT-3D* data over the central Himalaya, which captured ozone gradient and ozone peak altitude successfully, despite only one IR channel for ozone. These profiles were also validated utilizing balloon-borne observations. Simultaneous observations of organic carbon (OC) and elemental carbon (EC) were reported for the first time in the Himalayan region. During the lockdown period large reduction in particulate matter (PM) and air pollutants was found within the Delhi-NCR region as compared to similar periods in previous years with a significant increase after re-opening.

The technical team in ARIES comprising of engineers and other engineering staff were actively involved in the design, development, upgradation and upkeep of the observational facilities along with providing maintenance support for ARIES infrastructure. Continuous upgrades and addition of sophisticated instruments in the engineering division were taken up. The core engineering sections (optics, mechanical, electronics and computer) work in synergy adopting an integrated and interdisciplinary approach. In future ARIES will strengthen the ongoing programmes and will take initiatives for development of newer instruments for astronomy and atmospheric sciences research. With the 3.6m DOT fully operational, ARIES expects to increase active participation in the technical aspects of the Thirty Meter Telescope (TMT) project and use the technical know-how acquired with DOT. ARIES will also be on the lookout for an active participation and involvement in national and international projects such as the upcoming *Aditya-L1* and proposed projects such as NLST, NLOT and *INSIST*.

Several ongoing national and international collaborations were strengthened during this period. ISRO signed a MoU with ARIES for co-operation in Space Situational Awareness (SSA) and Astronomy & Astrophysics. In future ARIES, in collaboration with ISRO, will host the *Aditya-L1* Science Support Cell and take up new challenges in enhancing the computing and data archiving facilities.

As a part of our academic and outreach activity, we at ARIES regularly conduct public lectures, popular talks, and various other scientific activities (workshops/ schools) for students and public. We encourage the use of ARIES science center facilities and motivate the young talents toward a career in Astronomy & Astrophysics and Atmospheric Science. During this year most of our activities were conducted through virtual platform and social media. A series of 23 online e-lectures were delivered by ARIES researchers which were broadcast live on YouTube and facebook. Three

major astronomical events were covered by ARIES: i) Occultation of Pluto on 06 June, 2020 which was observed with ARIES 1.3m and 3.6m telescopes in optical and near infrared bands as a part of an international campaign, ii) Annular solar eclipse on 21 June, 2020 was observed with ARIES Solar telescope for a very short time due to cloudy sky condition. The event was broadcast live on YouTube and facebook. An online Zoom question answer session, hosted by me, was attended by 100 participants from nearby areas, iii) The Great Conjunction of Jupiter and Saturn on 21 December, 2020 was successfully captured with ARIES telescopes.

Several activities and programmes were conducted during the celebrations of *Constitution Day* and *Hindi Pakhwara* in ARIES. As a part of the curtain raiser ceremony of *India International Science Festival (IISF)* 2020, ARIES organised a half day workshop under the theme "*Self-Reliant India and Global Welfare*". *Vigilance Awareness Week* was observed in ARIES under the theme "*Satark Bharat, Samriddh Bharat*". The *National Science Day* was celebrated with full vigour engaging teams from nearby schools in online mode.

Three important conferences, as a part of the celebration of Golden Jubilee Commemoration year of DST, were held in online mode - i) *The first International Liquid Mirror Telescope (ILMT) workshop* (29 June - 1 July, 2020), ii) *Aerosol air quality, climate change and impact on water resources and livelihoods in the Greater Himalayas* (14-16 September, 2020), iii) *An Overview of Climate Change over South Asia: Observations and Modelling Perspectives* (9 December, 2020). A new initiative called *JAI-AWSAR* program for Ph. D. students of ARIES and IIA was announced. This was a joint initiative under the banner of DST-50 and IIA-50 celebrations.

The visual identity (logo) for ARIES, comprising a graceful and unique symbol, and the new website of ARIES, with several new additions and features, were launched.

11 new JRFs joined ARIES during this period. ARIES appointed 9 Post Doctoral Fellows (PDFs) and 4 new faculty members during 2020-2021. 2 students were awarded Ph. D. degree, while 3 have submitted their theses. Several graduate and post-graduate students from science and engineering disciplines were trained by ARIES via short-term projects on topics of current research. A new Computer Science Internship Programme (CSIP) was started to motivate young science and engineering students toward software oriented work in research such as archival of data, web development and observing tools. In future ARIES will enhance the manpower training aspect which will continue to be an integral part of our academic activities.

During the year of this report, ARIES staff constituted of 34 scientists and engineers, 12 administrative and support staff, 29 scientific and technical staff, 9 laboratory assistants. The major scientific task force of the institute constituted by the PDFs and research scholars were 12 and 55 respectively. The total number of research publications by ARIES faculty in refereed journals of high impact were 93.

With the increasing number of research scholars and staff at ARIES, development of new infrastructure (including laboratories, science center, hostel and canteen) and refurbishment of road are planned to be taken up shortly.

ARIES has taken several measures to keep the office premises and surrounding areas clean under the "*Swachh Bharat Campaign*". Sincere efforts are taken to build an equitable work environment by safeguarding the interests of women, schedule caste and tribes, and addressing the grievances of the staff members. The important schemes as directed by Government of India and the use of official language in administrative work are implemented in ARIES. We maintain the national integration in the institute.

I strongly believe that our institute will continue to enhance and excel in the academic activities utilising the state of the art observational facilities and participation in future projects of national and international importance.

Dipankar Banerjee
Director

Research Highlights

The researchers at ARIES comprising of scientists, research scholars and post doctoral fellows are engaged in research mainly related to topics in Astronomy & Astrophysics (A&A), Atmospheric Sciences and Instrumentation. These activities are carried out under the domain and expertise of three core divisions at ARIES. In this section, brief highlights of the scientific and instrumentation results of the institute, during the period 2020-21, are presented.

Astronomy & Astrophysics Division

The research areas in A&A division are concentrated 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), Theoretical and numerical simulations of compact objects.

The Sun and the Solar System

The Long-term study of the Sun

The Sun exhibits variations in different timescales starting from a few seconds to a few tens of years and even more. The variations that occur on larger time scales, for example, more than years, can be treated as long term variations. Long-term variations in the Sun are significant from the point of view of the climate. It will also have a long-term effect on our planet and heliosphere.

A large international collaboration, including researchers from ARIES, has produced a systematic recalibrated sunspot and plage area time series. Data from different solar observatories have been combined and recalibrated to make uniform time-series data. These consistent time series data will play a crucial role

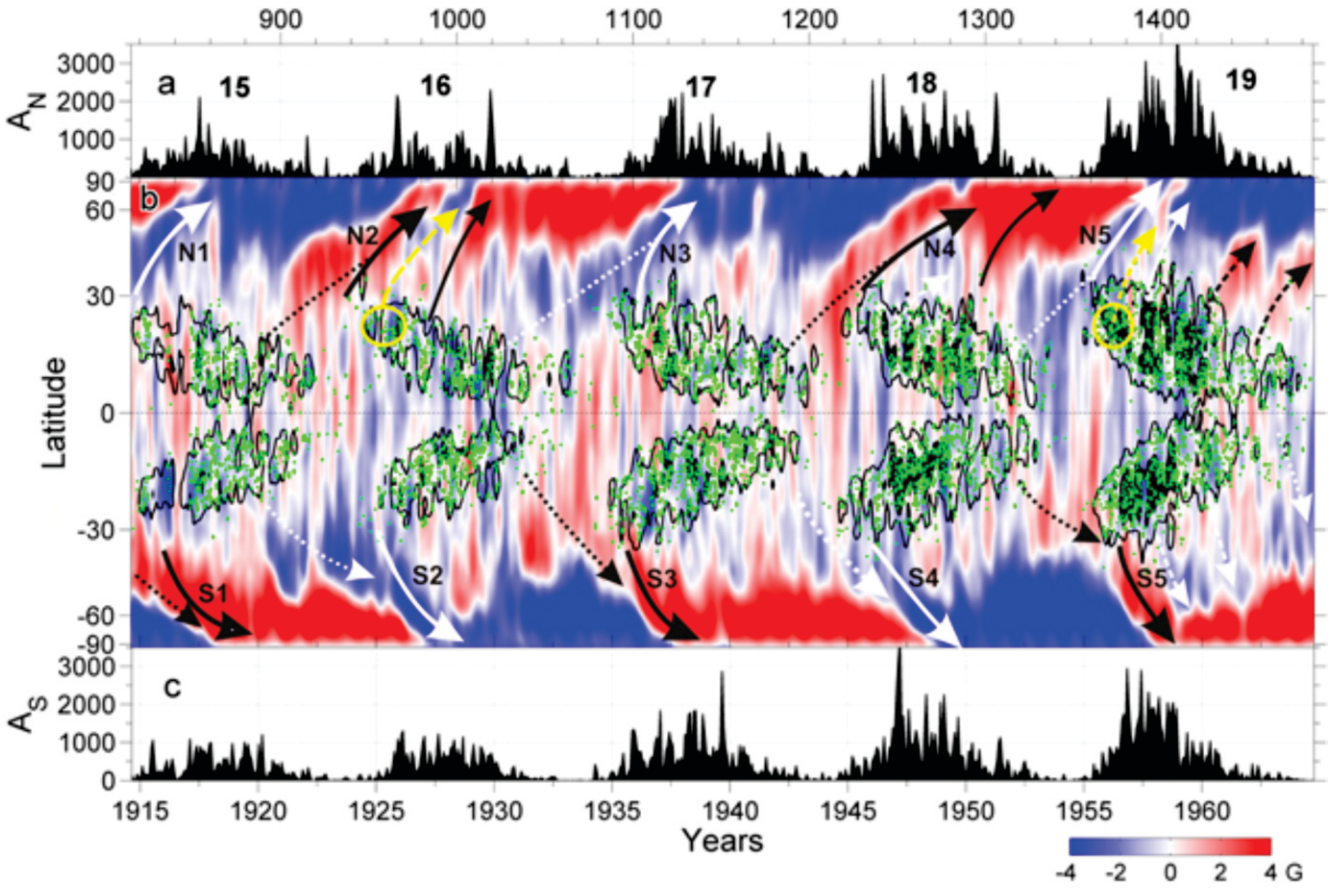


Figure 1. Butterfly diagram of reconstructed magnetic field on the solar surface. (a), (c) Temporal variation of the sunspot areas in the northern/southern hemisphere. (b) Zonally averaged magnetic field is shown in blue to red.

in understanding the secular variation of our nearest star. [Mandal, S., Krivova, A., Solanki, S. K., Sinha, N. & **Banerjee, D.** (2020). *Astron. & Astrophy., 640*, A78 (12pp); Chatzistergos, T., et al. (including **Banerjee, D.**) (2020). *Astron. & Astrophy., 639*, A88 (1-22pp)].

Even though the uniform sunspot and plage area data give an insight into the understanding of the solar magnetic field and its evolution, the actual observation of magnetic field of the Sun is only available from the 4th quarter of the 20th century onward. The researchers, within the framework of an Indo-Russian programme, have produced the pseudo magnetogram for solar cycles 15 to 19 (1915-1970) (**Figure 1**). The publicly open multi-wavelength digitized data from Kodaikanal Solar Observatory (KoSO), of the Indian Institute of Astrophysics (IIA, Bengaluru) was used to conduct this study. Furthermore, a proxy for the polar field has been studied using Hα data from different observatories. [Mordvinov, A. V., et al. (including **Banerjee, D.**). (2020). *Astrophy. Jr. Lett., 902* : L15 (6pp); Xu, Yan, et al. (including **Banerjee, D.**). (2021). *Astrophy. Jr., 909*: 86 (8pp)].

Another aspect of solar magnetic field evolution is based on the theoretical model called solar dynamo. The cyclic behavior of sunspot appearance or solar cycle is explained on the basis of the dynamo model. The solar differential rotation, which helps amplify the magnetic field in the Sun, also plays a significant role. An automatic technique to track the sunspots and measure the solar differential rotation was developed. This study revealed that the different sized (**Figure 2**) sunspots showed different rotation rate profiles, which helps to understand the solar dynamo and also puts some constraints for the sunspot simulations. Automated algorithms for extracting solar features from the hand-drawn sun charts for more than 100 years were also developed. These charts contain all the solar surface features which are seen in different filters at a single place, which will act as proxies for the understanding of the Sun. [**Jha, Bibhuti Kumar, Priyadarshi, Aditya,** Mandal, S., Chatterjee, S. & **Banerjee, D.** (2021). *Solar Physics, 296*: 25 (14 pp)].

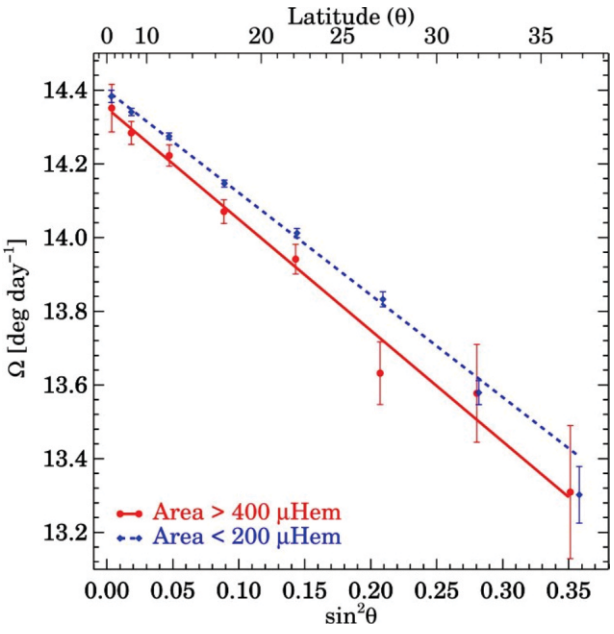


Figure 2. Rotation profiles of sunspots with area <200 μHem (blue dashed line) and with area >400 μHem (red solid line).

Study of the Coronal Mass Ejections (CMEs) in the solar corona

CMEs are massive explosions happening at the solar corona (the outermost atmosphere of the Sun). Despite extensive coronagraphy over the past few decades, a clear understanding of the kinematics of CMEs is yet to be achieved.

The COR-1 and COR-2 on-board the twin spacecraft *STEREO-A/B* perform stereoscopic observations of the inner and outer corona of the Sun. The actual kinematics of CMEs in 3D in the inner and outer corona were studied with the help of Graduated Cylindrical Shell (GCS) model. The observational evidence that the initial rapid expansion and acceleration were just veritable manifestation of the same Lorentz force that the CME is injected with during its ejection at its source region was established for the first time. It was also reported that statistically the height of influence of Lorentz force lies between 2.5-3$R_{\odot}$ height range. The true deflection of CMEs was also studied. Source regions were identified by back propagating the CMEs on the solar disc and it was found that these different source classes have an imprint on the kinematics as well. The CMEs coming from the active region class get propelled to much higher speeds and accelerations as compared to those originating from quiescent regions.

[Majumdar, S., Pant, V., **Patel, R.** & **Banerjee, D.** (2020). *Astrophy. Jr., 899*:6 (15pp)**]**.

An automated algorithm to detect accelerated CMEs in the solar atmosphere has been developed for the first time. The algorithm is based on the principle of parabolic Hough transform that detects parabolas in noisy data. The accelerated CMEs produce parabolas in the height-time maps, which are detected faithfully by this algorithm (**Figure 3**). **[Patel, R., Pant, V.**, Iyer, P., **Banerjee, D.,** Mierla, M. & West, M. J. (2021). *Sol. Phys., 296*: 31 (23pp)**]**.

The CME results will be quite useful for the future space missions such as VELC on-board *Aditya-L1* of ISRO, ASPIICS, on-board *PROBA-3*, etc. which will probe the kinematics of CMEs in the inner corona where they experience impulsive accelerations..

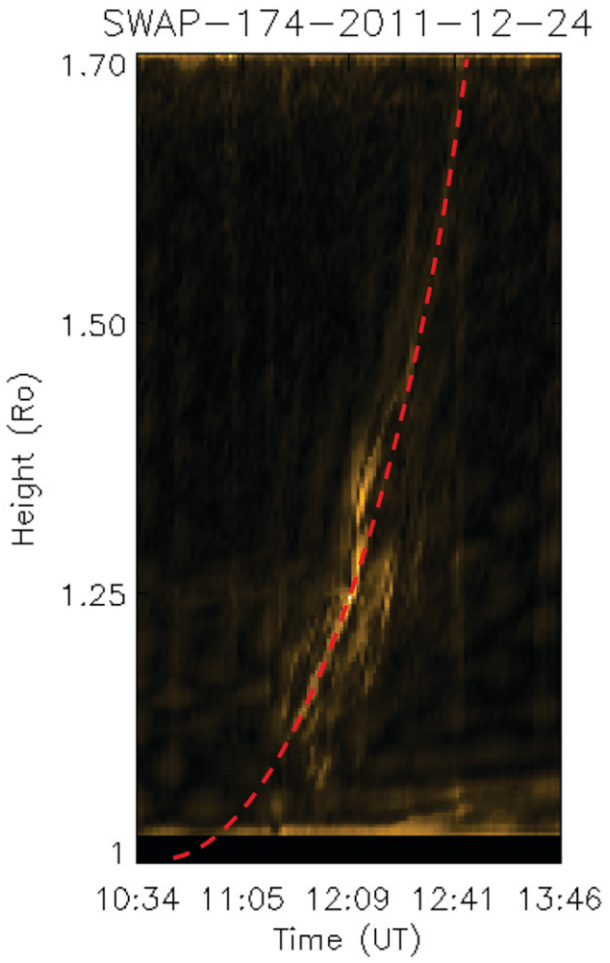


Figure 3. Application of parabolic Hough transform. The height–time plot of a solar eruption location with identified parabola over-plotted in dashed line.

Plasma Heating Induced by Tadpole-like Downflows in the Flaring Solar Corona

Solar flares, one of the most energetic events on the Sun, are generally powered by magnetic reconnection in the solar corona.

The re-arrangement of magnetic field lines after the reconnection process results in a series of new loop-like magnetic structures known as post-flare arcade loops. An extremely hot (5-10 MK) diffuse plasma region is also observed above the loops and is called a supra arcade region. Often, dark tadpole like structures are seen to descend through the bright supra-arcade regions (**Figure 4**).

It remains unclear what role these so-called supra-arcade downflows (SADs) play in heating the flaring coronal plasma. A unique flare observation, where many SADs collided with the post-flare loops and strongly heated the loops to a temperature of 10-20 MK, was presented. Several of these interactions generate clear signatures of quasi-periodic enhancement in the soft X-ray emission, providing an alternative interpretation for quasi-periodic pulsations (QPPs) that are commonly observed during solar and stellar flares. **[**Samanta, T., et al. (including **Banerjee, D.**) (2021). *The Innovation, 2*, 100083 (6pp)**]**

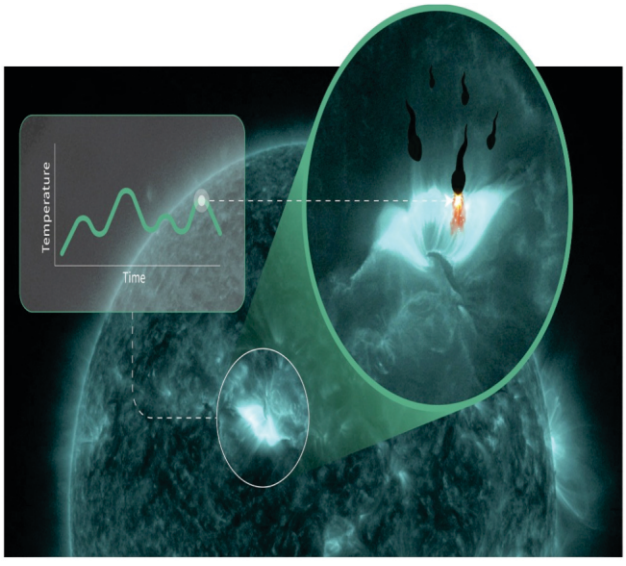


Figure 4. Tadpole-like flows known as supra-arcade downflows observed in a solar flare.

Galactic Astronomy

Variability in Stars and Star Clusters

Star clusters, usually of two main types - open and globular clusters, are large groups of stars. Variability studies in stars and identification of variable stars in star clusters using long term multi-wavelength observations have been performed.

Photometric variability study of a young (~2-3 Myr) star-forming region IC 348 in the Perseus molecular cloud was performed with the aim to explore fast rotation (in the time-scales of a few hours) in very low-mass stars including brown dwarfs (BDs). The photometric variability in 22 young M dwarfs including 6 BDs was presented. Out of these 22 variable stars, 11 M dwarfs including one BD showed hour-scale periodic variability in the period range 3.5-11 h while the rest were found to be aperiodic in nature. **[**Ghosh, S., et al. (including **Joshi, S.** & **Lata, S.**) (2021). *Mon. Not. Roy. Astron. Soc., 500,* 5106-5116**]**.

High temporal resolution photometric observations of SZ Lyncis, a binary star with one component as a high amplitude δ Scuti star, permitted the discovery of new frequencies and modes of pulsations. The physical parameters such as mass, density etc. of the star were also derived. **[**Adassuriya, J. et al. (including **Joshi, S.**). (2021). *Mon. Not. Roy. Astron. Soc., 502*, 541-555**]**.

A linear non-adiabatic stability analysis with respect to radial perturbations for models of κ Cassiopeiae was presented. Instabilities associated with the fundamental mode and the first overtone were identified for models with masses between 27 and 44 $M_{\odot}$. For selected models, the instabilities were followed into the nonlinear regime by numerical simulations. Amplitude pulsations with periods between 3 and 1.8 d were found. In the nonlinear regime, the instabilities may cause a substantial inflation of the envelope. **[**Yadav, A. P., **Joshi, S.** & Glatzel, W. (2021). *Mon. Not. Roy. Astron. Soc., 500*, 5515-5523**]**.

26 lunar occultation events were observed in a dedicated programme with the 1.3m DFOT along with TIRCAM2/DOT observations. The results consisted of the first-time angular diameters (**Figure 5**) for two late-type giants, in a measurement of the well-known asymptotic giant branch pulsating variable SW Vir, and the measurement of eight small separation binaries, one of which was detected for the first time (HR 1860). The wider binaries SAO 94431 and 55 Tau (twice) were also measured. The remaining sources were found to be unresolved with upper limits as small as 1 mas. In future, high-speed capability of TIRCAM2 instrument could be used to include more near-IR, highly extincted sources for observations in this programme. **[**Richichi, A., **Sharma, Saurabh, Sinha, T., Pandey, R., Ghosh, A.**, Ojha, D. K., **Pandey, A. K.** & Naik, M. B. (2020). *Mon. Not. Roy. Astro. Soc., 498*, 2263–2269**]**.

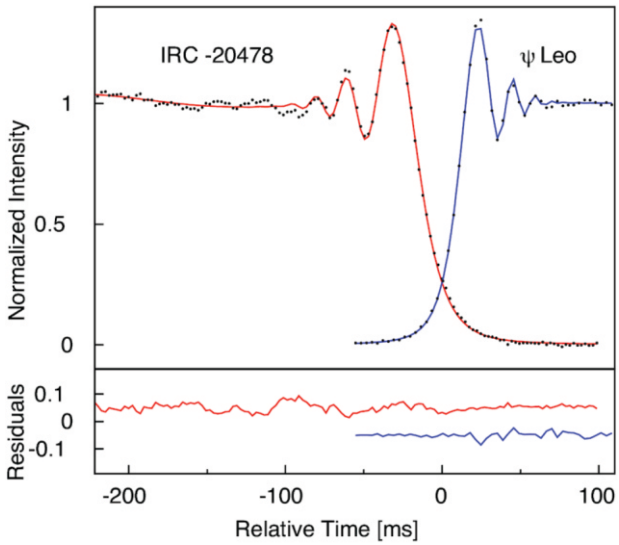


Figure 5. Top panel: Left, disappearance light curve (dots) for IRC−20478 and best fit by a UD model of 2.57 mas (solid line), including a scintillation correction by Legendre polynomials. Right, reappearance light curve (dots) for ψ Leo and best fit by a UD model of 3.03 mas (solid line). Bottom panel: fit residuals.

12 new transit light curves of the hot-Jupiter TrES-3b to probe the transit timing variation (TTV) were presented. New linear ephemeris and timing residuals were determined suggesting the possibility of TTV in TrES-3 system. The frequency analysis showed that the possible TTV is unlikely to be periodic, indicating the absence of any additional body in this system. Other possible origins of TTV were explored by fitting the orbital decay and apsidal precession ephemeris models to the transit time data. The apsidal precession ephemeris model was found to be statistically less probable than the other ephemeris models considered. However, the possibility of orbital decay cannot be completely ruled out in the TrES-3 system. **[**Mannaday, V. K. et al. (including **Joshi, Y. C.**, **Pandy, A. K.** & **Joshi, S.** (2020). *Astron. Jr., 160*: 47 (15pp)**]**.

Polarimetric observation of the cluster NGC 1817 has revealed two different groups of stars in the cluster having different polarimetric characteristics. The study suggested that both non-relaxed cloud and relaxed ISM layers were responsible for the polarisation of group 1 stars, whereas only the non-relaxed cloud was responsible for the polarisation of stars in group 2. The maximum value of the degree of polarisation was estimated to be 0.93% for members of the cluster using the Serkowski relation (**Figure 6**). The average value of wavelength corresponding to the maximum polarisation of 0.54±0.02 μm indicated that the size distribution of dust grains in the line of sight was similar to that of the general interstellar medium. The polarisation of the majority of stars was found to be ISM originated. However, a few stars might have an intrinsic component of polarisation showing either lower or higher values of degree of polarisation. **[Singh, Sadhana**, & **Pandey, J. C.** (2020). *Astron. Jr., 160*: 256 (13pp)**]**.

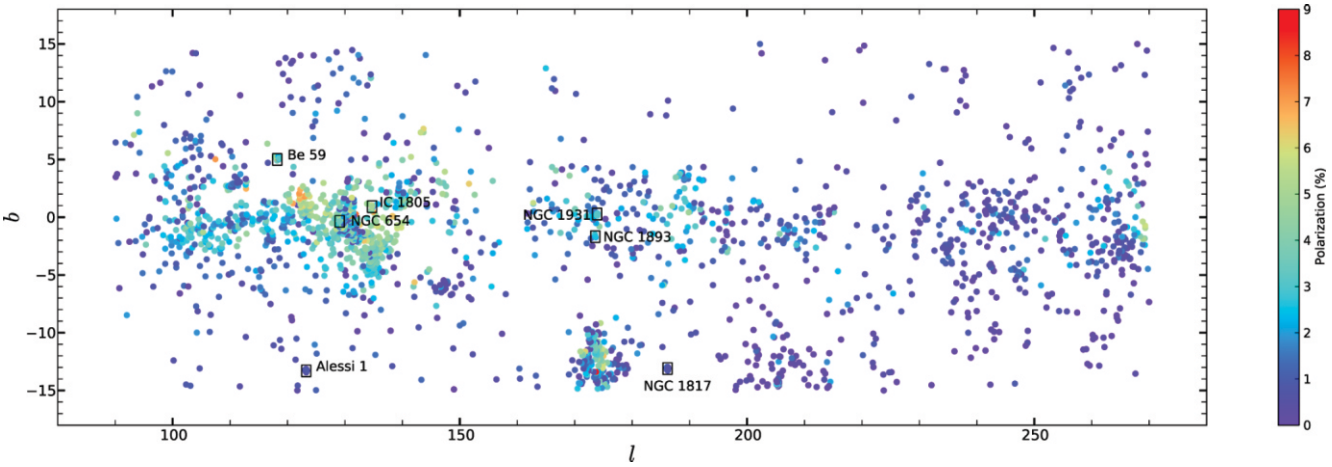


Figure 6. The distribution of the degree of polarisation in Galactic longitude (from 90° to 270°) and Galactic latitude (−15° to +15°).

Long-term V band photometric observations, acquired on 40 nights spanning a period of more than three years, were analysed to search for variable stars in the cluster NGC 559. 70 newly discovered variables including 67 periodic variables were reported for the first time. The periodic variables were further sub classified into different variability types on the basis of observational properties such as shape of the light curves, periods, amplitudes, as well as their positions in the Hertzsprung-Russell (H-R) diagram (**Figure 7**). **[Joshi, Y. C., John, Ancy A., Maurya, J., Panchal, A., & Kumar, Brijesh**. (2020). *Mon. Not. Roy. Astron. Soc., 499*, 618-630**]**.

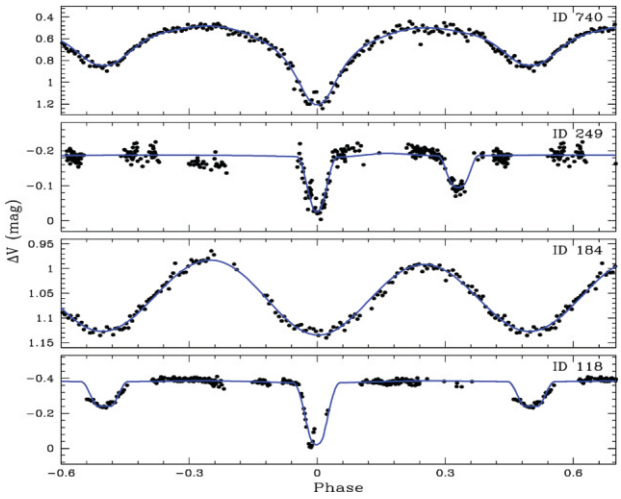


Figure 7. The light curves for four EBs including the ID 249 which is a cluster member. The continuous lines show the best model fits derived through the PHOEBE code.

19 variable stars were identified in four open clusters Berkeley 69, King 7, King 5 and Berkeley 20. 5 out of these showed δ Scuti-like variability and 2 W UMa type variability. Periodicity was identified in 8 stars with a period range of 0.13-0.43 days. Basic parameters like age and reddening were estimated for these clusters. **[**Durgapal, A. et al.(including **Yadav, R. K. S.** & **Pandey, J.C.** (2020). *Jr. Astrophy. & Astrno., 41*: 13 (10pp)**]**.

Star Formation and Evolution

The regions where star formation occurs and they predominantly contain very young stellar objects are known as star forming regions. The evolution and

formation of stars in star clusters and HII regions is studied using multi-wavelength data.

Emission from warm dust and polycyclic aromatic hydrocarbons (PAHs) in the circumstellar shells was found in young planetary nebulae (PNe) NGC 7027 and BD +30° 3639, with high resolution infrared imaging performed with TIRCAM2 on 3.6m DOT. Morphologies of these two PNe were examined. The analysis suggested dominance of neutral PAHs in BD +30° 3639 and higher ionisation and more processed PAH population in NGC 7027. **[**Anand, R. K. et al. (including **Kumar, Brijesh, Ghosh, Arpan & Sharma, Saurabh**). (2020). *Jr. of Astroph. Astron., 41*: 27 (11pp)**]**.

The spatial distribution and minimum spanning tree analyses of the young stellar population in Galactic HII region Sh2-112 revealed that most of the young stellar candidates are grouped toward the western boundary of the HII region. A radio compact source/ultra-compact HII region, powered by a B0-B0.5 star, was identified toward the north-west periphery. A curved rim-like structure toward the south-west boundary surrounded

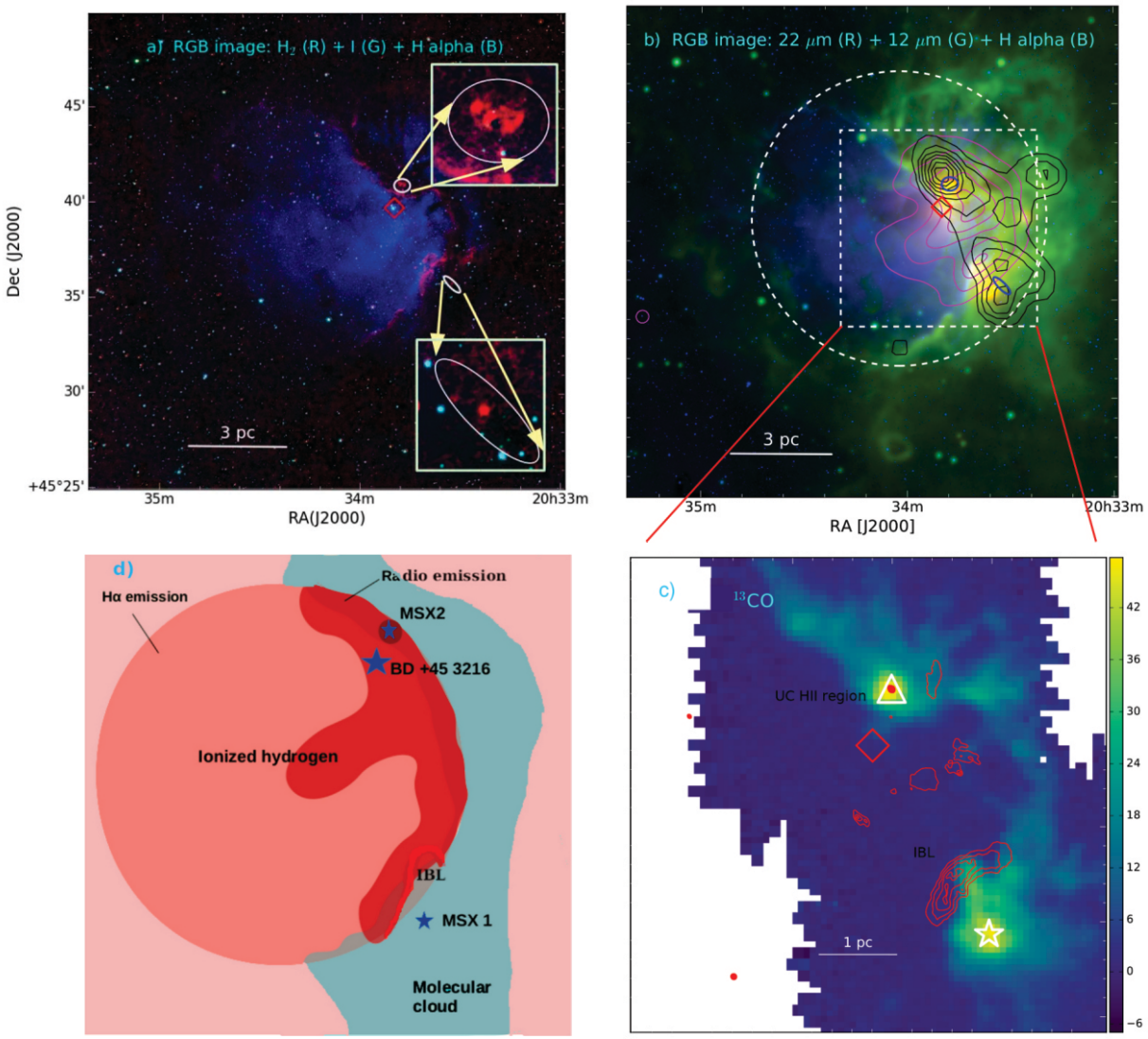


Figure 8. (a) An optical/infrared view of the Sh2-112 region. H2 emission (in red color) trace the boundary between the ionized and molecular gas and/or outflow from young stars. (b) Distribution of the heated dust (red and green color) and ionized gas (blue color) in the Sh2-112 region. The magenta contours show the distribution of the ionized gas obtained from GMRT data. The black contours represent the surface density distribution of the young stars. c) Distribution of the molecular gas as well as the locations of compact HII region and young massive stars in the region are shown. d) Cartoon diagram representing the morphology of the HII region Sh2-112.

by H_2 and ^{13}CO emission features was also located and suggested the presence of an ionized boundary layer (IBL) on the surface of the molecular cloud. Based on the distribution of the ionised gas, young stars and molecular material, the study suggested the HII region as a blister HII region developed on the surface of a cylindrical molecular cloud (**Figure 8**). **[Panwar, Neelam, Sharma, Saurabh**, Ojha, D. K., Baug, T., Dewangan, L. K., Bhatt, B. C. & **Pandey, Rakesh**. (2021). *Astroph. Jr., 905*: 61 (14pp)**]**.

Analysis of a 0°.27 × 0°.27 area around the Galactic HII region G18.88-0.49, powered by an O-type star (age ~10^5 yr), was performed. A shell-like feature was revealed with the *Herschel* column density map which was further confirmed by the distribution of molecular (^{12}CO, ^{13}CO, $C^{18}O$, and NH_3) gas at [60, 70] km s^{-1}. Four sub-regions, with a mass range of ~0.8-10.5 × 10^3 $M_\odot$, were studied toward this shell-like feature. These sub-regions associated with dense gas were dominated by nonthermal pressure and supersonic nonthermal motions. Five parsec-scale filaments were identified in the column density and molecular maps, and appear to be radially directed to the denser parts of the shell-like feature. This configuration is referred to as a "hub-filament" system. Significant velocity gradients were observed along each filament, suggesting that the molecular gas flows toward the central hub along the filaments. Overall, the findings favour a global nonisotropic collapse scenario which can explain the observed morphology and star formation in and around G18.88-0.49. **[**Dewangan, L. K. et al. (including **Sharma, S.**). (2020). *Astroph. Jr., 903*: 13 (17pp)**]**.

Multiscale and multiwavelength observations of the Galactic HII region S305, which is excited by massive O8.5V and O9.5V stars, were performed. Infrared images revealed an extended sphere-like shell enclosing the S305 H II region (size ~5.5 pc; age ~1.7 Myr). The molecular line data showed a signature of an expanding shell of molecular gas in S305. GMRT continuum maps revealed overdensities of the ionised emission distributed around two O-type stars surrounded by the horseshoe envelope (extension ~2.3 pc). This study provided the evidence of feedback of O-type stars in S305. Nonthermal radio emission was detected in S305 with an average spectral index α ~ -0.45. The variations in α ranging from -1.1 to 1.3 were explained due to soft synchrotron emission and either optically thicker thermal emission at high frequencies or a suppression of the low-frequency emission by the Razin-Tsytovich effect. **[**Dewangan, L. K. et al. (including **Sharma, Saurabh** & **Pandey, R.** (2020). *Astroph. Jr., 898*: 172 (16pp)].

An in depth analysis of the cluster NGC 6910 was carried out to study the physical properties of the cluster along with estimation of cluster parameters such as age, distance and reddening. The impact of massive stars on their environment was also examined. The mass function slope were estimated to be flatter than the Salpeter value which indicated the presence of an excess number of massive stars. The cluster showed mass segregation toward the central region due to their formation processes. The distribution of warm dust emission was investigated toward the central region of the cluster which showed the signature of impact of massive stars within the cluster region. Radio continuum clumps powered by massive B-type stars were traced that were located away from the center of the cluster NGC 6910. The presence of massive stars in the cluster might have triggered the birth of young, massive B-type stars in the cluster which is also supported with the observed age gradient between the cluster and the powering sources of the radio clumps. **[**Kaur, H. et al. (including **Sharma, Saurabh** & **Panwar, Neelam**). (2020). *Astroph. Jr., 896*: 29 (17pp)**]**.

Extra-Galactic Astronomy

Time Domain Astronomy

Studies of transients such as supernovae and gamma-ray bursts (GRBs) were studied in time domain astronomy utilising the longitudinal location of ARIES observational facilities combined with data at other wavelengths.

The broad band light curve of an interacting SN 2012ab (Type IIn) depicted a prolonged multi stage light curve evolution. A detailed spectroscopic study of SN 2012ab revealed a broad component due to freely expanding ejecta and a narrow component originating from pre-shock gas, which is later overtaken by the intermediate width component generated due to ejecta-circumstellar material (CSM) interaction. The presence of fast material both approaching and then receding is suggestive that the SN is observed along the axis of a jet-

like ejecta in a cavity devoid of or uninterrupted by CSM in the innermost regions (**Figure 9**). **[Gangopadhyay, A.** et al. (including **Misra, K., Kumar, Brajesh, Singh, Mridweeka, Dastidar, R., Kumar, Brijesh** & **Pandey, S. B.** (2020). *Mon. Not. Roy. Astron. Soc., 499*, 129-148**]**.

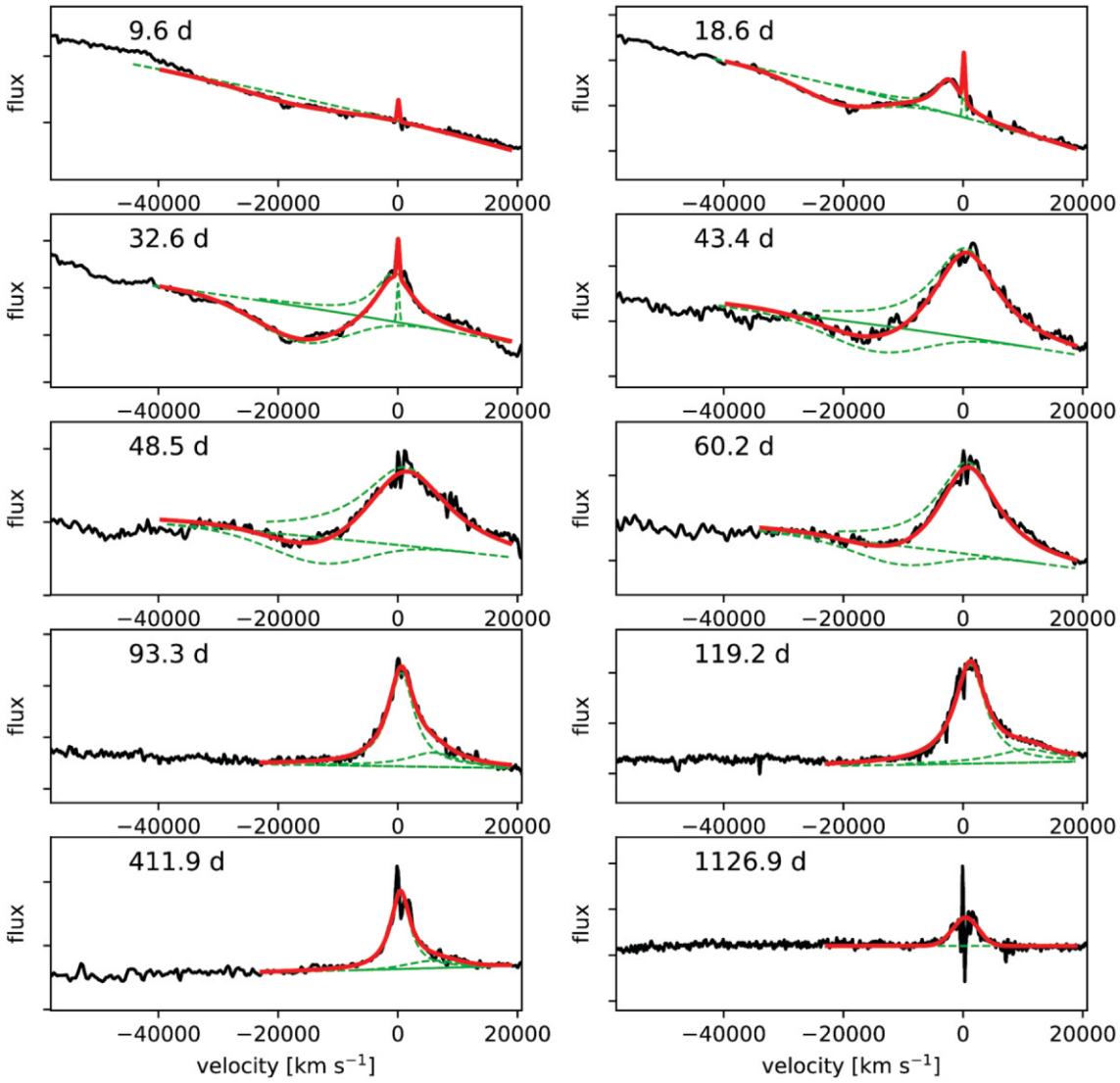


Figure 9. Best fit (red continuous line) to the observed Hα line profiles (black line) and individual components (green dashed). The fit has been performed on background subtracted SN spectra. Zero velocity corresponds to the Hα rest position.

A detailed investigation of three stripped envelope supernovae SNe 2015ap (Type Ib), 2015dj (Type Ib) and 2016P (Type Ic) was accomplished using photometric and spectroscopic observations. The peak magnitudes of the supernovae were estimated to be M_V = -18.04, −17.37 and -17.53 mag for SNe 2015ap, 2015dj and 2016P respectively indicating that SN 2015ap is the brightest amongst these. ^{56}Ni mass powering the peak luminosity in these supernovae was determined by modeling the bolometric light curve. However, modeling indicate that SNe 2015ap and 2016P were powered by a combination of ^{56}Ni and a magnetar component (**Figure 10**). Modeling of nebular phase spectrum estimated the progenitor mass to be between 12-20 $M_\odot$ in the case of SNe 2015ap and 2015dj. **[Gangopadhyay, A.** et al. (including **Misra, K., Dastidar, R., Kumar, Brijesh, Singh, Mridweeka, Pandey, S. B.,** & **Sanwal, Pankaj**). (2020). *Mon. Not. Roy. Astron. Soc., 497*, 3770–3789; **Singh, Mridweeka**, et al. (including **Misra, K., Gangopadhyay, A.** & **Dastidar, R.**). (2021). *Astrophy. Jr., 909*: 100 (12pp)**]**.

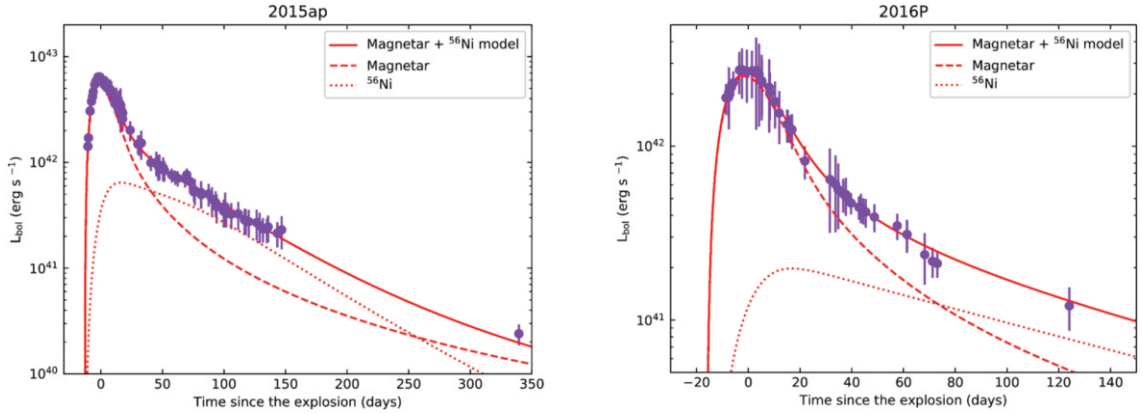


Figure 10. The bolometric light curves of SNe 2015ap (left panel) and 2016P (right panel) reproduced by the Magnetar + ^{56}Ni model. The abscissa represents time since the explosion in rest frame.

SN 2018ivc, an unusual Type IIL like supernova, exploded in a complex CSM environment in the well-studied Seyfert 2 galaxy NGC1068. The rapidly changing light curve signified that interaction between the CSM and ejecta plays a significant role in the evolution. Presence of circumstellar interaction was further supported by a strong X-ray detection. The spectra showed a rapid evolution and were dominated by hydrogen, helium, and calcium emission lines. A thorough inspection of several parameters hinted that the progenitor of SN 2018ivc could be as massive as 52 $M_{\odot}$ but is more likely <12 $M_{\odot}$. **[**Bostroem, K. A., et al. (including **Dastidar, R., Gangopadhyay, A.** & **Misra, K.)** (2020). *Astrophy. Jr., 895*:31 (20pp)**]**.

Very late observations of two long duration GRBs 160625B and 160509A with *HST*, *Chandra* and JVLA were used to calculate the post jet break decay indices. Afterglow modeling using BOXFIT suggested both the bursts to be energetically consistent with a millisecond magnetar central engine but requiring the magnetar parameters to be extreme (i.e., E ~ 3×10^{52} erg). BOXFIT does not reproduce the late-time radio light curves of both GRB afterglows and were found to be inconsistent with predictions of the standard jet model; instead, both were well represented by a single power-law decline with no breaks. This requires a highly chromatic jet break (tj,radio > 10 × tj,optical) and possibly a two-component jet could better explain the afterglow behaviour for both the bursts. **[**Kangas, T., et al. (including **Misra, K.)** (2020). *Astrophy. Jr., 894*:43 (14pp)**]**.

Fermi and *Swift* observations of the High Energy Stereoscopic System (H.E.S.S.)-detected GRB 190829A revealed two isolated sub-bursts or episodes separated by a quiescent phase with the energetic and spectral properties in the two episodes in stark contrast with each other. The observational facts discerned GRB 190829A as a peculiar low-luminosity GRB that was not powered by shock breakout, and has an unusual rebrightening due to patchy emission or a refreshed shock during the afterglow. The underlying supernova SN 2019oyw, of Type Ic, associated with GRB 190829A was powered by Ni decay and found to possess similar properties as SN 1998bw but evolved earlier in time. **[**Chand, V., et al. (including **Gupta, R., Dimple, Pandey, S. B.** & **Kumar, Amit**). (2020). *Astrophy. Jr., 898*:42 (13pp); Hu, Y. -D., et al. (including **Kumar, A., Gupta, R., Pandey, S. B.** & **Aryan, A.**). (2021). *Astronomy & Astrophysics, 646*, A50 (9 pp)**]**.

External Galaxies

The properties of external galaxies (star forming and tidal dwarf galaxies) such as gas and stellar mass are studied using optical Hα and HI radio observations.

The GMRT HI map does not show HI detection associated with KUG 2359+311, nor any HI tail or bridge-like structure connecting KUG 2359+311 to the NGC 7805/6 system. Hα image displayed strong detections in KUG 2359+311, with net SFR ~ 0.035 ± 0.009$M_{\odot}$ yr of KUG 2359+311 to 0.00 ≤ z ≤ 0.043, compared to the redshift of NGC 7806 of ~ 0.015. TDGs detected to date have all been HI rich, and displayed HI, ionised gas and stellar tidal debris trails (bridges or tails) linking them to their parent systems. However, neither HI data nor optical imaging, while being three magnitudes deeper than SDSS (**Figure 11**),

revealed a tidal trail connecting KUG 2359+311 to NGC 7805/6. Lack of HI , presence of an old stellar population, ongoing star formation and reasonably high SFR compared to normal dwarf galaxies suggest that KUG 2359+311 may not be an Arp 112 TDG. It is most likely a case of a regular gas-rich dwarf galaxy undergoing a morphological transformation after having lost its entire gas content to an interaction with the Arp 112 system. Redshift and metallicity from future spectroscopic observations of KUG 2359+311 would help clarify the nature of this enigmatic structure. **[**Fu, Zhen-Xing, et al. (including **Pradhan, B., Singh, M.** & **Misra, K.**) (2021). *Res. Astrono. Astroph., 21*, 43 (8pp).]

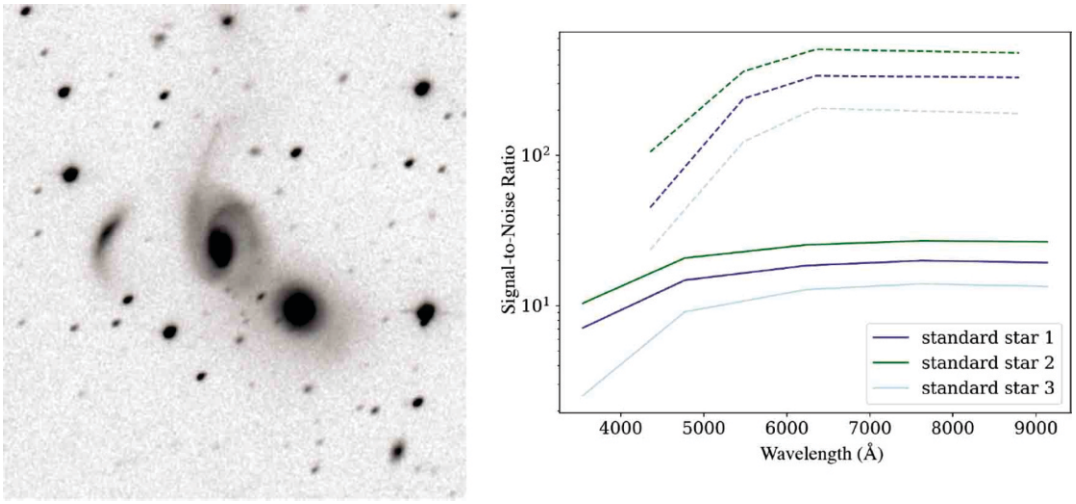


Figure 11. Left: Optical R-band image of the Arp 112 field, obtained by combining data from the 1.0m ST and the 1.3m DFOT. Right: SNR comparison of the 1.0 m ST observation with the SDSS images. The solid lines and dashed lines correspond to SDSS and 1.0 m telescope images, respectively.

The GMRT observations of the HI 21cm-line emission combined with 1.3m DFOT observations from 13 nearby dwarf star-forming galaxies were used to derive physical conditions, gas and stellar masses in the galaxies. These galaxies are residing in low galaxy density environments. A significant HI mass deficiency was noticed in majority of the galaxies for their optical diameters as compared to galaxies in field environments. Clear signatures of tidal interactions in these galaxies could be inferred using the HI images. Isolated HI clouds without known optical counterparts were seen in the vicinity of several galaxies. HI emission envelope was found to be having an offset from the optical envelope in several galaxies. Consistent with the previous studies on galaxy evolution in group environments, tidal interactions seem to play an important role in triggering recent star formation in dwarf galaxies. [**Jaiswal, S.** & **Omar, A.** (2020). *Mon. Not. Roy. Astron. Soc., 498*, 4745–4789].

Narrow-line Seyfert 1 galaxies

Narrow-line Seyfert 1 galaxies (NLSy1s) are a peculiar class of lower luminosity active galactic nuclei (AGNs) and were initially classified as radio-quiet objects, which were thought not to eject relativistic jets like those observed in radio-loud AGNs.

A systematic Intra-Night Optical Variability (INOV, a tool to trace the jet activity in AGNs) study of a high energy detected sample of 18 NLSy1s (detected in X-rays, but undetected in γ-rays, x_NLSy1s) and 7 NLSy1s (detected in γ-rays and, in some cases, in X-rays as well, g_NLSy1s) suggested that radio loudness level was the prime factor behind the INOV detection in NLSy1 galaxies and the pattern of the high energy radiations played a minor role. **[Ojha, V., Chand, H., Gopal-Krishna, Mishra, S.** & **Chand, K.** (2020). *Mon. Not. Roy. Astron. Soc., 493*, 3642-3655].

A dedicated INOV study of γ-ray detected NLSy1s, discovered to date, resulted in high duty cycle and the amplitude of INOV was found to be similar to the blazar class of AGN. This suggested that relativistic jets can also be launched from the lower black hole mass AGNs such as γ-ray NLSy1s. **[Ojha, V., Chand, Hum** & **Gopal-Krishna**. (2021). *Mon. Not. Roy. Astron. Soc., 501*, 4110-4122**]**.

The properties of a large sample of NLSy1 were studied and compared with the control sample of Broad-line Seyfert1 (BLSy1) galaxies in X-ray and optical bands (**Figure 12**). A very good correlation was found among X-ray photon indices (Γ^{s}_{X}) and the Eddington ratios (R_{Edd}) for both NLSy1 and BLSy1 galaxies. This provided clear evidence of the difference in Γ^{s}_{X} and R_{Edd} distributions among NLSy1 and BLSy1 galaxies, with steeper Γ^{s}_{X} and higher R_{Edd} for the former as compared to the latter. It was concluded that the higher Eddington ratio in NLSy1 was responsible for its steeper X-ray spectral slope as compared to its L-z matched sample of BLSy1s, consistent with the disc-corona model as proposed for the luminous AGNs. **[Ojha, V., Chand, H.**, Dewangan, G. C. & Rakshit, S. (2020). *Astrophy. Jr., 896*: 95 (22pp)**]**.

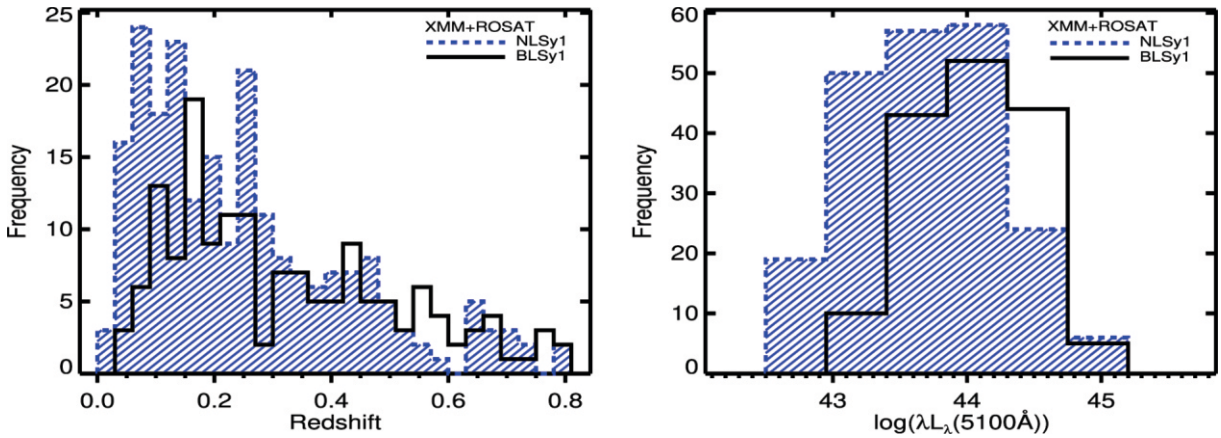


Figure 12. Left: Distribution of emission redshifts. Right: λL_{λ}(5100 Å) for the *XMM-Newton*- and *ROSAT*-detected combined samples of 221 NLSy1s (blue filled histogram) and 154 BLSy1s (black open histogram).

The general physical properties of NLSy1s are typically known upto z = 0.8. Although only a couple of NLSy1s are known beyond z = 0.8, it is possible that there are γ-ray-emitting NLSy1s beyond z = 1. The high-z NLSy1 spectra were searched from the SDSS archive. The correlation between several continua and line properties of AGN and the strong correlation between FWHM of MgII and Hβ lines (**Figure 13** left panel) resulted in 2684 NLSy1 candidates at the redshift range of 0.8-2.5. The average logarithmic black hole mass of this sample was found to be 8.01 ± 0.35 $M_{\odot}$ and logarithmic Eddington ratio of 0.02 ± 0.27 (**Figure 13** right panel). **[Rakshit, S.**, Stalin, C. S., Kotilainen, J. & Shin, J. (2021). *Astrophy. Jr. Supl. Sr., 253*: 28 (10pp)**]**.

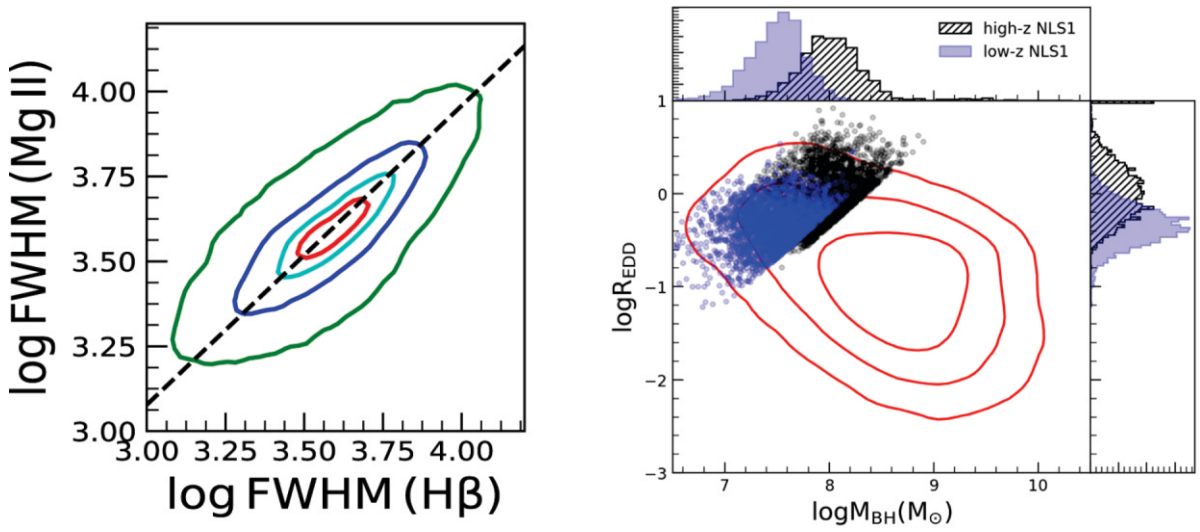


Figure 13. Left: The correlation between FWHM of MgII and Hβ is shown for SDSS Dr14 quasars. Right: The Eddington ratio vs. black hole mass of high-z NLSy1 along with low-z NLSy1 and SDSS quasars are shown.

Variability in Blazars

Blazars are the most luminous and energetic class of AGNs with a relativistic jet. Temporal flux and spectral variabilities of different blazars are studied on diverse time scales using multi-wavelength data. Flux and spectral variabilities are a dominant tool to explain jet as well as disk emission from blazars at different epochs of observations.

Multi-wavelength flux and spectral variability of blazars BL Lacertae, S5 0716+714 and H 2356-309 were reported on diverse time scales. The shortest timescale of variability at optical frequencies observed with TESS was found to be 0.5 hour in BL Lacertae. Multi-wavelength correlated variability with some time lags was observed in BL Lacertae and S5 0716+714. No significant intraday flux and spectral variability was found in H 2356-309. The X-ray spectral curvature were well described by log parabolic and power law models. **[**Weaver, Z. R. et al. (including **Gupta, A. C.**). 2020, *Atrophy. Jr., 900*: 137 (26pp); Raiteri, C. M., et al. (including **Gupta, A. C.** & **Dhiman, V.**) (2021). *Mon. Not. Roy. Astron. Soc., 501*, 1100-1115; Wani, K. A. & **Gaur, H.** (2020). *Galaxies, 8(3)*, 59 (12pp); **Gaur, H.** (2020). *Galaxies, 8(3)*, 62 (7pp)**]**.

The temporal and spectral study of the BL Lacertae object OJ 287 during September 2019-March 2020 indicated flux variability between 8-31% in different energy bands. The X-ray emission was found to be dominated by soft photons below 2 keV. Soft X-ray and optical/UV emission differ by ~45 days. The X-ray spectra followed a weak "softer when brighter" trend. **[**Kalita, N., **Gupta, A. C.** & Gu , M. (2020). *Galxies, 8(3),* 58 (10pp)**]**.

Three extreme TeV blazars, 1ES 0229+200, 1ES 0414+009 and 1ES 2344+514, displayed flux and spectral variability on diverse timescales in optical bands (**Figure 14**). A bluer-when-brighter trend was only detected in the blazar 1ES 0414+009. Large

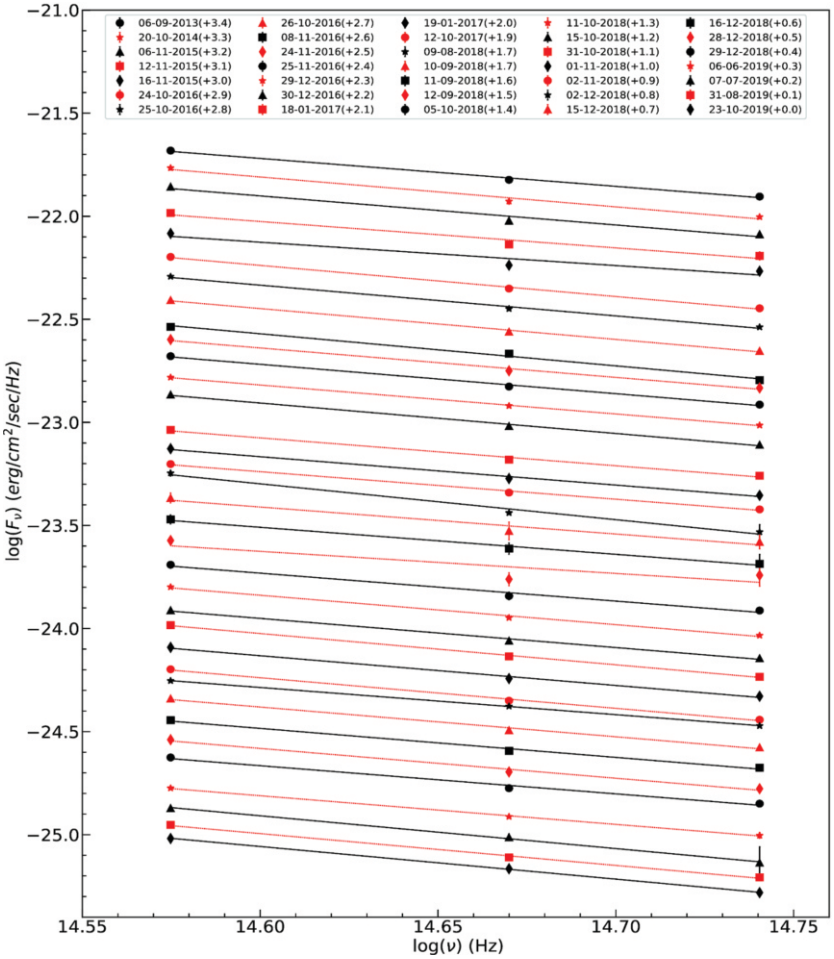


Figure 14. Optical SEDs of 1ES 2344+514 in V, R, and I bands.

amplitude intraday X-ray variability was seen in TeV-emitting high synchrotron peak blazar PKS 2155-304. It was found that the hard and soft X-ray emissions were emitted from the same population of leptons, with the emission being co-spatial. Hardness ratio provided an estimate of spectral variability on intraday timescales. The typical behaviour of high synchrotron peak blazars, "harder when brighter" and vice versa, was followed in this source. Power spectrum density was found to be red noise dominated. **[Pandey, Ashwani, Gupta, A. C.** et al. (2020). *Mon. Not. Roy. Astron. Soc., 496*, 1430–1444; Zhang, A., et al. (including **Gupta, A. C.** & **Gaur, H.**) (2021). *Astrophy. Jr., 909*: 103 (13pp); **Gupta, A. C.** et al. (2020). *Galaxies, 8(3)*, 64 (15pp)**]**.

Single electromagnetic band and simultaneous multi-band quasi-periodic oscillations (QPOs) were detected and reported in a few blazars. A probable γ-ray QPO of about 314 days was detected in the 0.1-300 GeV light curve of the blazar OJ 287 (**Figure 15**). Simultaneous optical and gamma-ray QPOs were detected in blazars CTA 102 and 3C 454.3 with periods of 7.6 days and 47 days, respectively. Multi-band radio (4.8, 8.0 and 14.5 GHz) QPOs were detected in the blazar AO 0235+164 with a dominant period of 965 days. The variety of QPOs observed in different blazars were explained with the dominant emission mechanisms. **[**Sarkar, A. et al. (including **Kushwaha, P.** & **Gupta, A. C.** (2020).

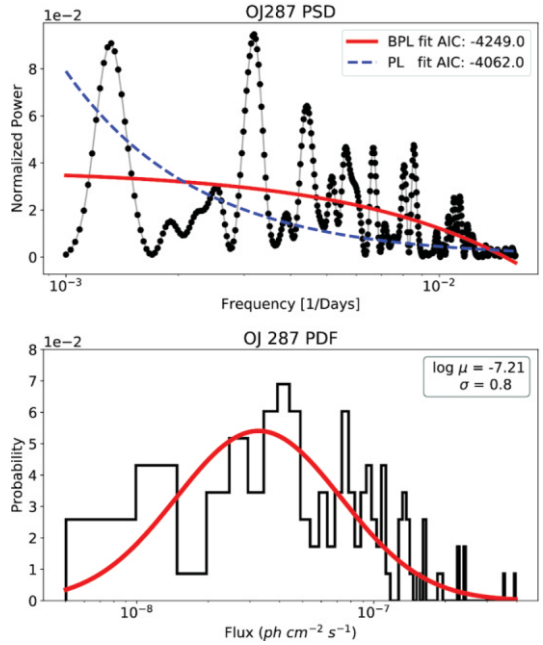


Figure 15. Top: power spectrum of the light curve and Bottom: observed flux distribution of the blazar OJ 287 along with the best fit models.

Astron. & Atrophy., 642, A129 (9pp); **Kushwaha, P.** et al. (including **Gupta, A. C.**). (2020). *Mon. Not. Roy. Astron. Soc., 499*, 653-658; Sarkar, A., et al. (including **Gupta, A. C.**). (2021). *Mon. Not. Roy. Astron. Soc., 501*, 50-61; Tripathi, A., et al. (including **Gupta, A. C.**). (2021). *Mon. Not. Roy. Astron. Soc., 501*, 5997-6006].

Numerical and Theoretical Astrophysics

Numerical and theoretical astrophysics studies are centered around simulations of compact objects like black holes and neutron stars.

Matter around compact objects like black holes are very hot and, therefore, are in the plasma state. Because of the different masses, the dynamics of electrons and protons are different and they tend to settle down into two different temperature distributions and hence the name `two-temperature flows'. These flows suffer from the problem of degeneracy, which mainly arises because the number of flow variables is more than the number of equations of motion. But matter falling onto a black hole will find a unique solution! In this work a novel methodology to obtain this unique solution was proposed. Entropy comes as a saviour as it ensures that out of all the solutions corresponding to the same constants of motion (Bernoulli parameter and accretion rate), the one with the highest entropy will be chosen by nature. However, the presence of an electron-ion interaction term in the first law of thermodynamics prevents a quantitative measure of entropy throughout the flow. But, remembering the fact that close to the black hole horizon, gravity dominates all other processes including the Coulomb interaction term; an expression of entropy of the accreting matter was calculated. The second law of thermodynamics dictates that the solution with the maximum entropy will be favoured by nature, so degeneracy in two-temperature flows were removed. Thereafter, the unique accretion disc solutions around black holes were investigated extensively. Spectral analysis of accretion discs around supermassive black holes showed that the spectrum is broad-band, while for stellar-mass black holes emission was majorly in the X-ray regime. Further, it was concluded that low accretion rate systems were radiatively inefficient; while as the accretion rate of system increases, more efficient accretion discs are formed. Interestingly, 90% of the total luminosity was found to come from a region of less than

5 Schwarzschild radii (**Figure 16**). **[Sarkar, Shilpa, Chattopadhyay, I.**, & Laurent, P. (2020). *Astron. & Astroph., 642*, A209 (21pp)**]**.

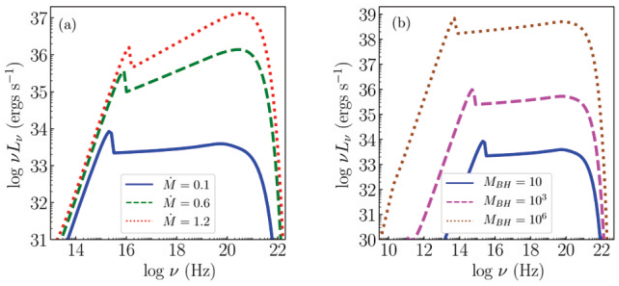


Figure 16. Spectra from (a) $M_{BH} = 10\,M_{\odot}$ for different accretion rates (b) $\dot{M} = 0.1\,\dot{M}_{Edd}$ for different M_{BH}. Other disc parameters are E = 1.001 and λ = 2.4.

Mass outflow is common around both stellar-mass black holes in microquasars as well as around supermassive black holes in AGNs. However, in the hard non-thermal spectral states, accretion discs around black holes produce collimated, fast, relativistic outflows called jets. While in the soft-thermal spectral states (the accretion disc is said to be Keplerian in this spectral state), uncollimated, slow non-relativistic outflows known as winds are observed.

Production of winds by radiation driving off material on the top of the accretion disc, when the system is in the soft-thermal state was investigated using numerical simulations. Unlike other works, a hot environment was considered here where line driving is not dominant. In the electron scattering regime too, the radiation drag effect was taken into account. Radiation penetrates an optically thin medium. However, as it pushes the matter to achieve higher velocity, the radiation field ahead impedes the outflowing wind. So radiation accelerates as well as decelerates. This study highlighted that the radiation drag limits terminal speed upto 10% of the speed of light as well as reduces the mass outflow rate. It was found that the drag effect along the z-direction was less than that in azimuthal and radial directions. A fraction of the ejected material falls back and destabilizes the outflow, and the whole outflow column sways from one side to the other. It was also shown that the radiation drag can quench the wind completely (**Figure 17**). **[**Raychaudhuri, S., Vyas, M. K., & **Chattopadhyay, I.** (2021). *Mon. Not. Roy. Astron. Soc., 501*, 4850-4860].

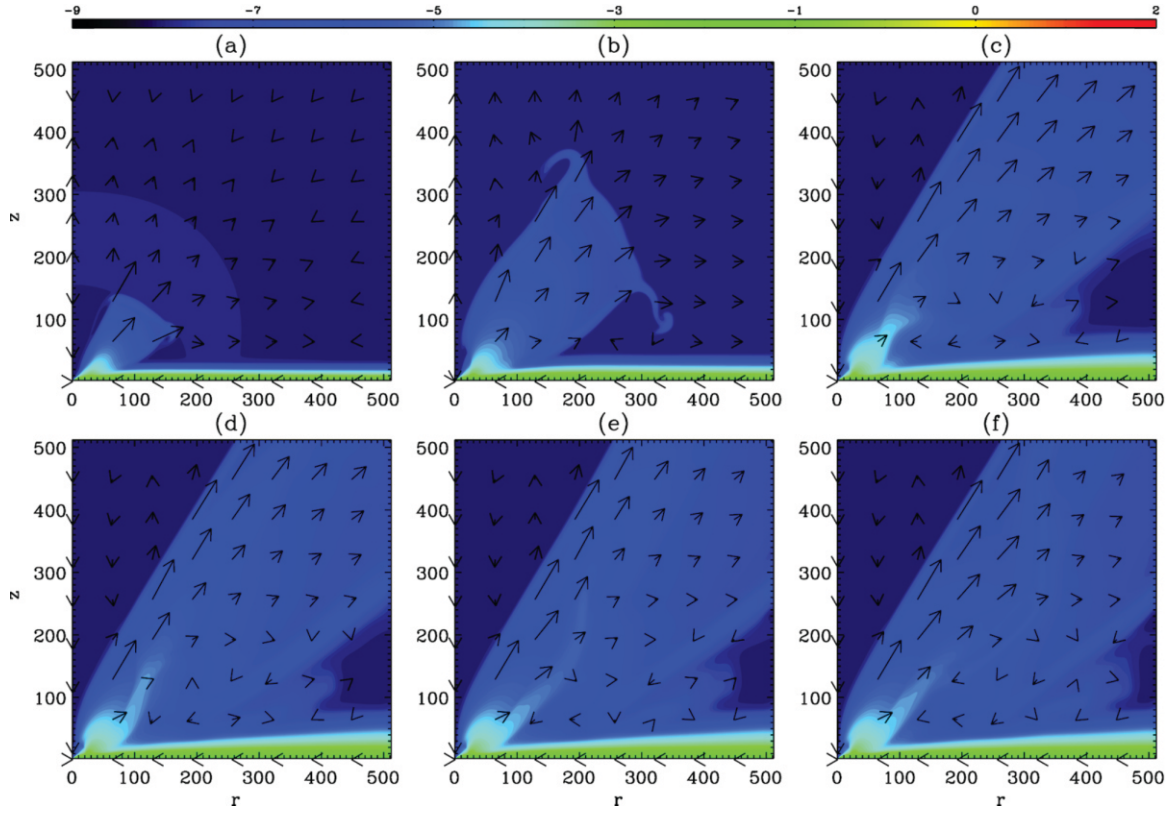


Figure 17. Contours of density log10(ρ) overplotted with respective net velocity vector arrows. These profiles are for m˙=3. Panels correspond to the snapshots at run time t = 2, 6, 62, 72, 82, and 92 from (a) to (f).

Atmospheric Sciences Division

The research activities in Atmospheric Sciences division are oriented toward better understanding of complex processes (physical, chemical and dynamical) which are governing the Earth's lower atmosphere.

Aerosols and Meteorology

The Indo-Gangetic Plain experiences heavy air pollution due to various anthropogenic and natural activities which are further exacerbated by seasonal meteorological conditions. As a result, this region is a major aerosol hotspot.

Monitoring of Air Pollution over Indo-Gangetic Plain

Particulate Matter ($PM_{2.5}$) levels and the associated dynamics were investigated across the Indo-Gangetic Plain. Utilizing ground based observations, satellite data and models a widespread enhancement in fine particulate matter was found toward winter. **[**Ojha, N. et al. (including **Singh, N.** (2020). *Nature Scientific Reports, 10*, 5862 (11 pp)**]**.

Seasonal variability of aerosol vertical structure over the Indian mainland was investigated using decadal daily datasets (2009-2018). Significant increasing trends were observed in aerosol extinction within lower altitudes during all seasons. The seasonal variability and trends of aerosol extinction over five selected cities (based on pollution and population levels) of the country were also examined. **[**Mehta, M., Khushboo, R., Raj, R. & **Singh, N.** (2021). *Atmos. Envir., 244*, 117902 (13pp)].

Large reduction in $PM_{2.5}$ levels were found over Delhi-NCR region during the first week of lockdown (25-31 March, 2020) as compared to the pre-lockdown conditions. The study suggested a haze formation mechanism through uplifting of fine particles, reinforced by condensation of moisture following the sunrise. It highlighted a highly complex interplay between the baseline pollution and meteorology leading to counter intuitive enhancements in pollution, besides an overall improvement in air quality during the lockdown. **[**Dhaka, S. K. et al. (including **Singh, N.**) (2020). *Nature Scientific Reports, 10*, 13442 (8 pp)].

In another study the impact of COVID-19 lockdown (25 March-17 May, 2020) period was observed in PM mass concentrations and air pollutants (NOx, SO_2, CO, NH_3, and O_3) within Delhi-NCR region. Large reductions in PM_{10}, $PM_{2.5}$, NO_2, NO, CO, NH_3, and a slight increase in O_3 as compared to the same period in previous years was observed. After re-opening, significant increase in pollution levels was observed (**Figure 18**). However, the meteorological changes during this period were

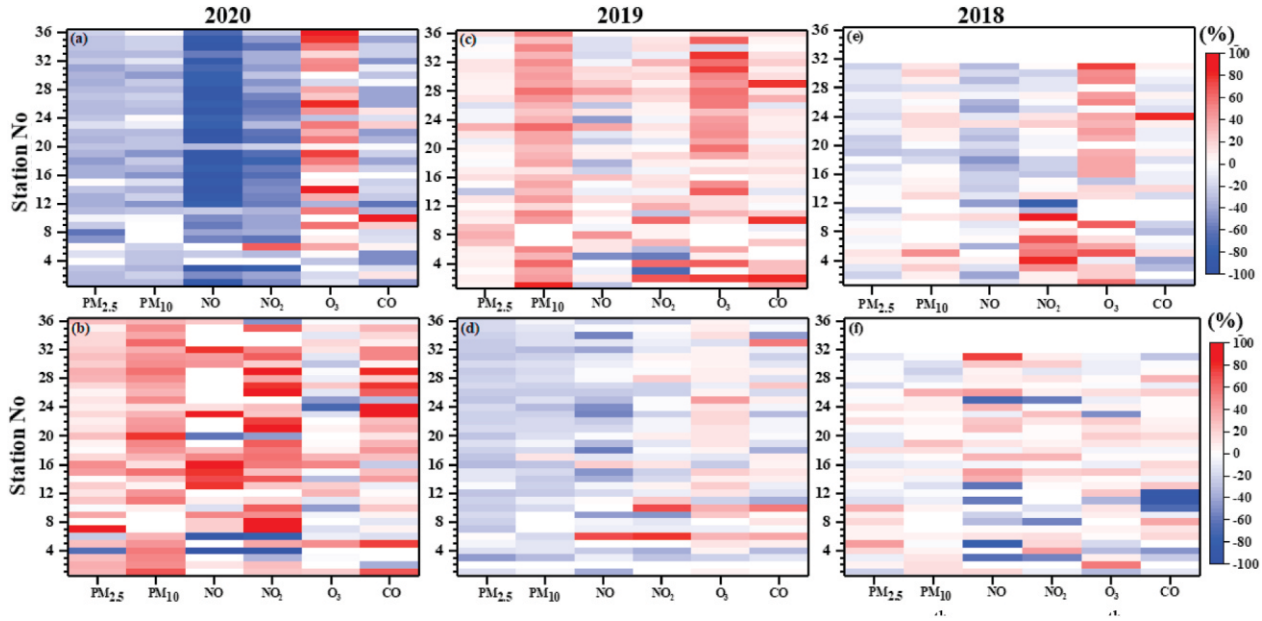


Figure 18. Percentage (%) changes in air pollutants between the lockdown (25 March-17 May, 2020) and pre-lockdown (01-24 March 2020) (upper panels), and post-lockdown (18 May-4 June, 2020) (lower panels) periods at stations in Delhi and respective changes during the same periods in 2019 and 2018.

rather marginal. Weather Research and Forecasting (WRF)-CHIMERE model simulations revealed a remarkable reduction in $PM_{2.5}$, NO_2 and SO_2 levels over the entire Indian subcontinent and mostly over urban areas, due to depletion in vehicular and industrial emissions. The simulation demonstrated the usability of the model as a powerful tool for studying air pollution. **[Dumka, U. C.** et al. (2021). *Atmos. Pollution Res., 12*, 225-242.**]**.

The WRF model was extensively evaluated against the Ganges Valley Aerosol Experiment (GVAX) observations during summer monsoon. The WRF simulation was performed at different resolution levels over the Central Himalaya. It was found that the WRF model setup at finer spatial resolution can significantly reduce the biases in simulated meteorology. WRF simulated a dominant easterly wind component and an underestimated south-easterly component. The prediction of wind direction was significantly improved by implementing a high-resolution topography input in the model. **[Singh, J., Singh, N.,** et al. (2021). *Geoscientific Model Development, 14*, 1427-1443].

Carbonaceous Aerosols in the Himalayas: Role of Meteorology and Biomass Burning

Key aerosol types and the role of particle size in aerosol classification were examined for the first-time over the central Himalayan region using in-situ measurements of aerosols' optical and microphysical properties from the GVAX campaign. Based on the classification matrix SAE vs AAE thresholds (Scattering vs absorption Ångström exponents, respectively), seven aerosol types were identified which are highly dependent on particle size (**Figure 19**). The aerosol type named "large/BC mix" dominated in both PM_1 and PM_{10} mass, characterized by the aged BC mixed with other aerosols indicating a wide range of particle sizes and mixing states. The small particle with low spectral dependence of absorption (AAE<1) accounted for 31.6% and BC-dominated aerosols for 14.8% in PM_1, while in PM_{10} a large fraction (39%) corresponded to "large/low-absorbing" aerosols and only 3.9% was characterized as "BC-dominated". Further, the remaining aerosol types consisted of mixtures of dust and local emissions from biomass/biofuel burning and displayed very small fractions. The aerosol optical properties such as spectral scattering, absorption, single scattering albedo, activation ratio, as well as seasonality and dependence on wind speed and wind direction of aerosol types were examined and revealed a large influence of air masses originating from the Indo-Gangetic Plains. **[Dumka, U. C.**, Kaskaoutis, D. G., Mihalopoulos, N. & **Sheoran, R.** (2021). *Sci. of the Total Enviro., 761*, 143188].

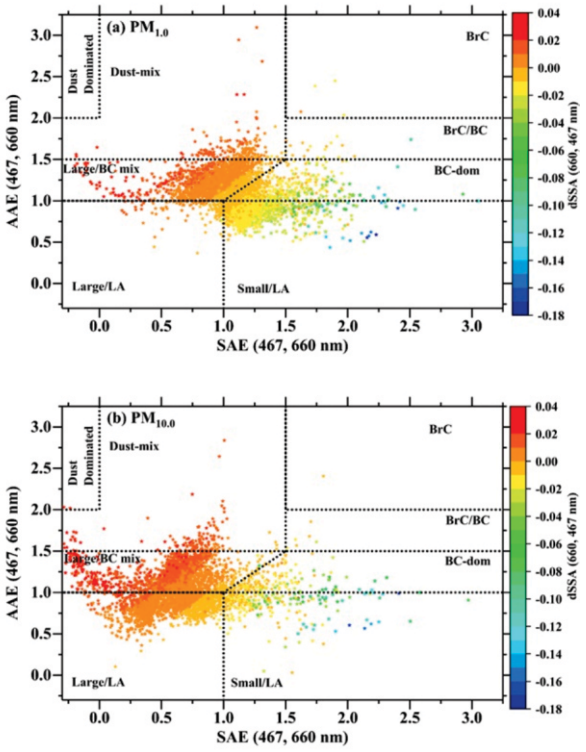


Figure 19. Classification scheme SAE vs AAE for identification of various aerosol types and mixture states in Nainital for (a) PM_1 and (b) PM_{10} particles based on the Cappa et al.'s (2016) matrix. The data points are color coded according to the dSSA values.

Year long observations in 2016 were carried out to understand the seasonal variability and transport of equivalent black carbon (EBC) aerosols, for the first time from a high-altitude site Ranichauri (2200 m amsl) in the lesser Himalaya. A large enhancement in [EBC] was observed toward the end of April due to emissions from fire events along the Himalayan foothills. The mean [EBC] levels were found to be higher during winter and pre-monsoon periods, and the lowest during summer monsoon period. The study attributed wintertime [EBC] maximum to confinement of the regional anthropogenic emissions within the shallow boundary layer. **[**Pandey, C. P., Singh, J., Soni, V. K., **Singh, N.** (2020). *Atmos. Pollu. Res., 11*, 1199-1210**]**.

Sampling of carbonaceous species like organic carbon (OC) and elemental carbon (EC) in ambient total

suspended particulates (TSP) was carried out at Bhimtal (high altitude urban, 1413 m amsl) and Pantnagar (lowland urban, 224 m amsl) in Kumaon division, Uttarakhand during the winter and summer of 2017-2018. Total carbonaceous aerosols (TCA) were higher at Pantnagar than at Bhimtal, more so during the winter. The estimated TCA accounted for ~ 30% of total TSP at both the sites. Most of the carbonaceous parameters exhibited contrasting positive and negative correlations with the boundary layer height, temperature, and solar radiation at Bhimtal and Pantnagar, respectively. **[**Kumar, A., et al. (including **Singh, N.**). (2021). *SN Applied Sciences, 3*: 83 (14pp)**]**.

Simultaneous observations of OC and EC were made for the first time in the Himalayan region and provided a diurnal variation with a unimodal pattern (**Figure 20**) in both OC and EC at the high-altitude site of Nainital (1958 m amsl). Seasonal variations in OC and EC were seen with a primary maximum during spring and a secondary maximum in autumn/winter with the maximum hourly values in May. Concentration weighted trajectory (CWT)– assisted analysis showed that biomass burning in northern India is one of the major sources for the springtime maximum even at this high-altitude site. The rise in OC/EC ratio also coincided with fire events, further establishing that the enhancement in the concentrations is due to biomass burning at distant regions and long-range transport of air masses. Poor covariation between OC-EC and the boundary layer height during autumn and winter

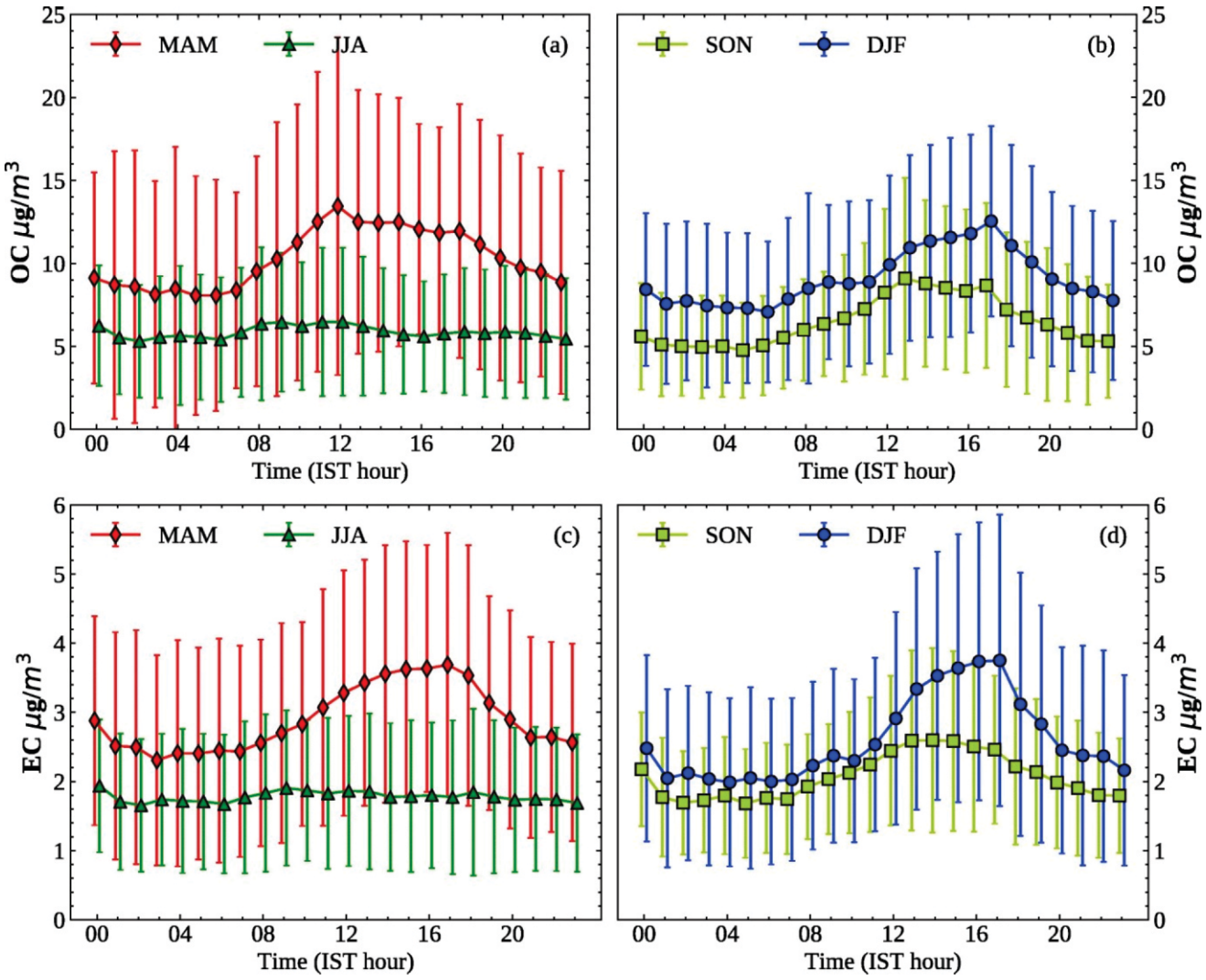


Figure 20. Average diurnal variations in OC and EC during winter (DJF), spring (MAM), summer monsoon (JJA) and autumn (SON) at Nainital (2014-2017).

suggested that secondary maxima in OC and EC were most likely due to local sources, e.g. heating households with firewood. The diurnal variations of EC were used to estimate the atmospheric radiative forcing that showed higher values in afternoon than forenoon. **[Srivastava, P.** and **Naja, M.** (2021). *Enviro. Sci. Pollution Res., 28*, 14654–14670**]**.

Aerosols and water vapour studies in the troposphere and lower stratosphere

Extensive balloon-borne observations were carried out from ARIES to study the effect of Asian Summer Monsoon (ASM) on the upper troposphere, lower stratosphere and aerosol layer near tropopause as a part of StratoClim balloon campaigns. Aerosol backscatter measurements were made by the Compact Optical Backscatter Aerosol Detector (COBALD) instrument during monsoon (August, 2016) and post-monsoon (November, 2016). The analysis revealed a variety of factors contributing to the observed day-to-day variability in aerosol layer near tropopause: continental convection, tropical cyclones (maritime convection), dynamics of the anticyclone and stratospheric intrusions. Thus, the air in the Asian Tropopause Aerosol Layer (ATAL) is a mixture of air masses coming from atmospheric layers at different altitudes. The location of the strongest updraft along the backward trajectories revealed a cluster of strong upward transport at the southern edge of the Himalayan foothills. Cases with a strong aerosols layer near the tropopause typically show boundary layer contributions from the Tibetan Plateau, the Himalayan foothills and other continental regions below the Asian monsoon. Weaker aerosols layer shows higher contributions from the maritime boundary layer, often related to tropical cyclones, indicating a mixing of clean maritime and polluted continental air.

LiDAR based observations from ARIES revealed an aerosols layer at an altitude of 4-6 km above msl during winter and pre-monsoon periods. Back-air trajectory analysis showed that the westerly/northwesterly winds with magnitudes of about 6–9 m/s are conducive for the generation and strengthening of such aerosols layers. It was shown that these aerosols layers can warm up the atmosphere by about 1.3 K/day. Analysis of carbonaceous species and trace elements in PM_{10} were made from samples collected at ARIES. The significant positive correlation of PM_{10} with crustal elements (Al, Fe, Ca, Mg and Ti) as well as correlation of Al with other crustal elements (Fe, Ca, Mg and Ti) indicated the abundance of mineral dust at the site. Principal component analysis (PCA) identified the contribution of crustal/soil dust, biomass burning and industrial emissions to the PM_{10} over the central Himalaya. Extensive observations were also made using frost point hygrometers under StratoClim balloon campaigns at ARIES to investigate the efficiency of wall contact and freezing of supercooled droplets in the intake tube. It was shown that the airflow can enter the intake tube with impact angles up to 60°, owing to the pendulum like motion of the payload. Supercooled droplets with radii >70 µm, as they frequently occur in mid-tropospheric clouds, typically undergo contact freezing when entering the intake tube, whereas only about 50% of droplets with 10 µm radius freeze, and droplets <5 µm radius mostly avoid contact. **[**Jorge, T., et al. (including **Naja, M.**). (2021). *Atmos. Measu. Tech., 14*, 239–268; Hanumanthu, S. et al. (including **Naja, M.**).(2020). *Atmos. Chem. Phys., 20*, 14273-14302; **Shukla, K. K., Phanikumar, D. V.,** Kumar, K. N., **Kumar, Ashish, Naja, M.**, Sharma, Som & Attada, R. (2021). *Jr. of Atmos. Solar-Terrestrial Phys., 213*, 105526 (11pp); Sharma, S. K., et. al. (including **Srivastava, Priyanka & Naja, M.**). (2020). *Jr. Atmos. Chem., 77*, 49-62.**]**.

Dynamics

Atmospheric dynamics involve study of diverse physical processes such as global and regional circulations, convections, thunderstorms, gravity waves etc.

A newly installed ARIES Stratosphere Troposphere (ST) Radar system was utilized for the first ever estimation of turbulence parameters over the central Himalayan region. Radar observations and simultaneous and colocated GPS-radiosonde observations were used for the years 2017 and 2019. In this context, turbulence parameters like turbulent kinetic energy dissipation rate, and eddy diffusion coefficient due to thermal and momentum fluctuations, were determined using ST radar observations in synergy with radiosonde measurements using Thorpe length scale method. Statistical distribution of turbulence parameters derived from radar and radiosonde was found to agree reasonably well. The refractive index structure constant (Cn^2) showed a decreasing tendency with height, and it was found to vary as large as 10^{-14} to as small as 10^{-19}

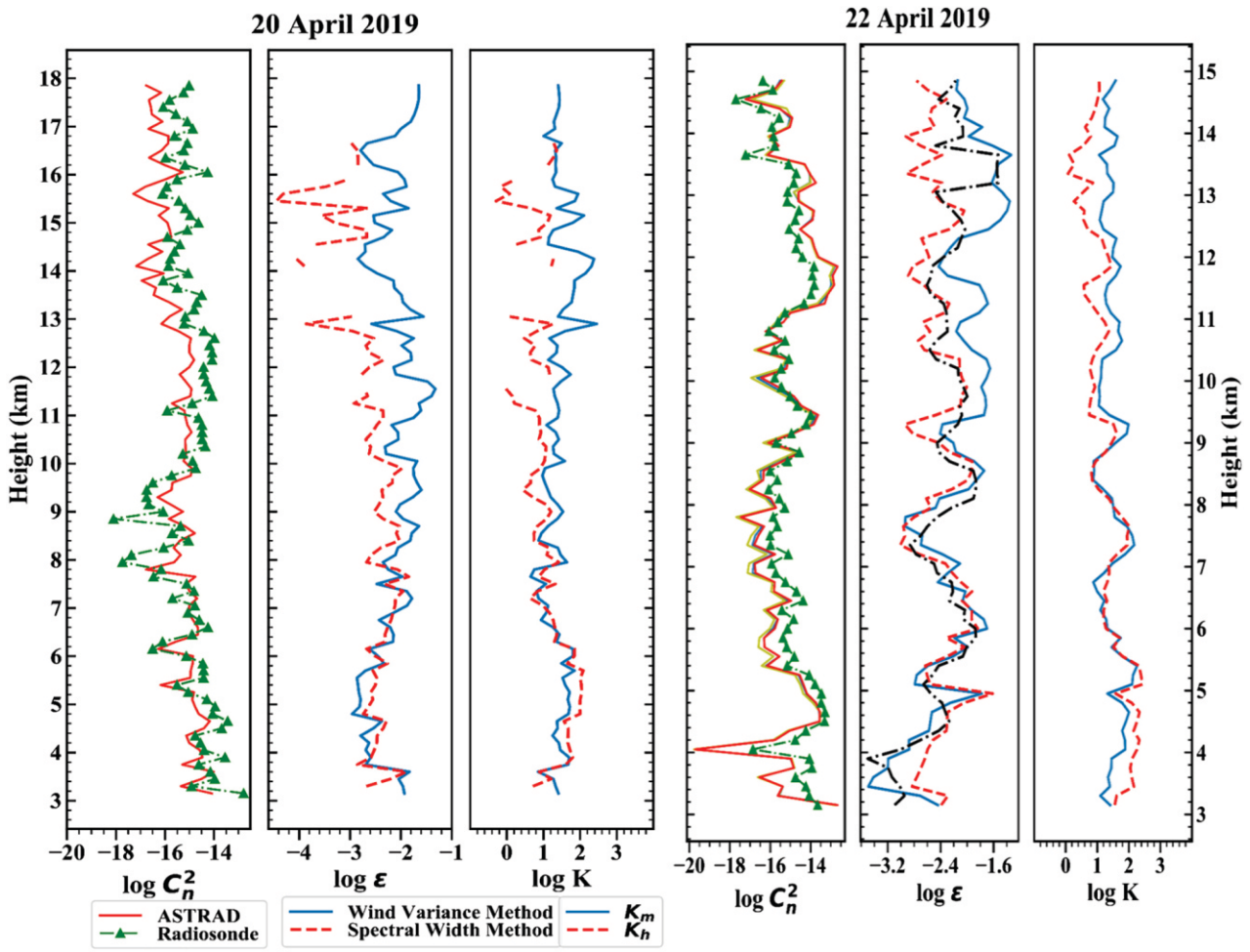


Figure 21. Vertical variations in Cn^2 from ARIES ST Radar and GPS Radiosonde on 20 and 22 April, 2019. Vertical distributions in turbulence parameters is also shown.

$m^{-2/3}$ (**Figure 21**). Range and temporal variation of signal-to-noise ratio (SNR) indicated the existence of a stable layer around 8 km height. It was also evident from the present study that the turbulence parameters at this central Himalayan region of complex terrain were higher by 1 order of magnitude than those reported from the southern part of India. **[Jaiswal, A., Phanikumar, D. V., Bhattacharjee, S. & Naja, M.** (2020). *Radio Science, 55*, e2019RS006979**]**.

Trace Gases

Surface and balloon-borne observations of several trace gases, including greenhouse gases, were done.

For the first time, vertical distributions of ozone have been retrieved using data (2013-2017) from *INSAT-3D* over the central Himalaya and validated utilizing balloon-borne observations from a high-altitude site in Nainital. The *INSAT-3D* retrieved ozone profiles captured ozone gradient and ozone peak altitude successfully (**Figure 22**), despite there being only one IR channel for ozone. This demonstrates the capability of the *INSAT-3D* Sounder in capturing the observed features, with a smaller bias in the stratosphere and somewhat larger bias in the troposphere. Total ozone column from *INSAT-3D* showed maximum difference of 8% with ozonesonde-derived total ozone column. Larger ozone bias in the lower troposphere could be attributed to lower reliability of regression coefficient and *INSAT-3D* channel constraints itself, whereas high variability near the tropopause was possibly due to low ozone, poor temperature retrieval near the tropopause and stratosphere–troposphere transport process in the Himalayan region. **[Rawat, P.**, et al. (including **Naja, M. & Bhattacharjee, S.)** (2020). *Current Science, 119*, 1113- 1122.]

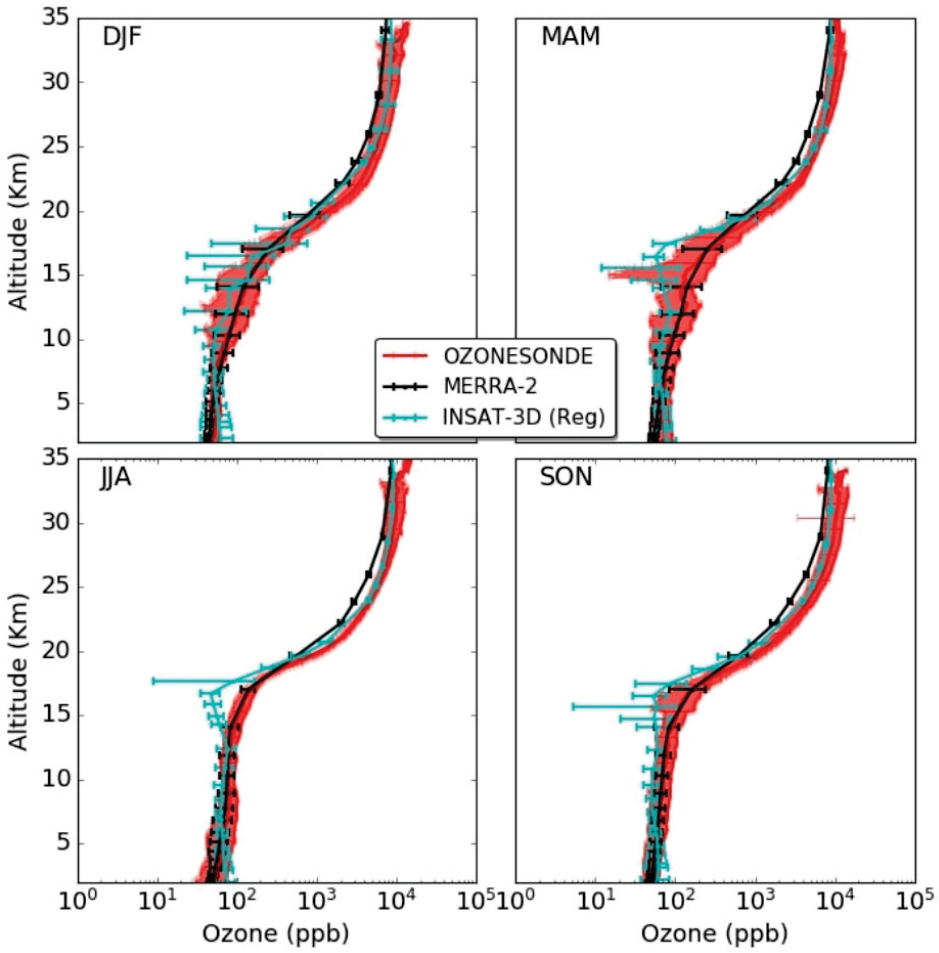


Figure 22. A comparative seasonal ozone profiles among balloon-borne ozone observations, INSAT-3D and MERRA-2 reanalysis.

Instrumentation

Design, development, maintenance and upgradation of observing facilities and other instruments are carried out at ARIES.

In-house development of cable twister was carried out at ARIES to route and support the cables of backend instruments of 3.6m telescope through azimuth center. Key features of cable twister were its flexible design, easy routing of cables and quick detachability. Highlights of the paper were space challenges, economical design, manufacturing, assembly, installation and testing of the cable twister with DOT. **[Bangia, Tarun & Uddin, W.** (2020). *Jr. of Astronomical Instrumentation, 9 (3)*, 2050012 (11pp)**]**.

Observations with DOT in different exposure times have allowed to estimate the sensitivity of point sources and extended sources in optical and near infrared bands. Stars of B = 24.5±0.2, R = 24.6±0.12 and g = 25.2±0.2 mag in exposure times of 1200, 4320 and 3600 s respectively were detected. In one hour of exposure time, a distant galaxy of 24.3± 0.2 mag and point sources of ~25 mag have been detected in the SDSS i band. The NIR observations show that stars up to J = 20±0.1, H = 18.8±0.1 and K = 18.2±0.1 mag can be detected in effective exposure times of 500, 550 and 1000 s respectively. The nbL band sources brighter than ~9.2 mag and strong ($\geqslant$ 0.4 Jy) PAH emitting sources could also be observed with DOT. A binary star with angular separation of 0."4 has been resolved by the telescope. Sky images with sub-arcsec angular resolutions were observed at wavelengths ranging from optical to NIR for a good fraction of observing time. The on-site performance of the telescope was found to be at par with the performance of other similar telescopes located elsewhere in the world. **[Sagar, Ram, Kumar, Brijesh & Sharma, S.**. (2020). *Jr. Astroph. Astrn., 41*: 33 (10pp)].

List of Publications

Refereed Journals

Astronomy & Astrophysics

1. Panja, A., Mondal, S., Dutta, S., **Joshi, S.**, **Lata**, **S.** & Das, R. (2020). Census of the young stellar population in the galactic H II region Sh2-242. *Astron. Jr., 159:*153 (17pp).

2. **Ojha, V.**, **Chand, H.**, **Gopal-Krishna, Mishra**, **S.** & **Chand, K.** (2020). Comparative intranight optical variability of X-ray and gamma-ray-detected narrow-line Seyfert 1 galaxies. *Mon. Not. Roy. Astron. Soc., 493,* 3642-3655.

3. **Maurya, J.** & **Joshi, Y. C.** (2020). Photometric and kinematic study of the three intermediate age open clusters NGC 381, NGC 2360, and Berkeley 68. *Mon. Not. Roy. Astron. Soc., 494*, 4713-4729.

4. Kangas, T., et al. (including **Misra, K.**) (2020). The late-time afterglow evolution of long gamma-ray bursts GRB 1600625B and GRB 160509A. *Astrophy. Jr., 894*:43 (14pp).

5. Durgapal, A., Bisht, D., Rangwal, G., Kaur, H. & **Yadav, R. K. S.** (2020). Study of open cluster king 13 using CCD VI, 2MASS and Gaia DR2. *New Astronomy, 78*, 101365 (1-9pp).

6. Bisht, D., Zhu, Q., **Yadav, R. K. S.**, Durgapal, A. &Rangwal, G. (2020). A comprehensive study of open clusters Czernik 14, Haffner 14, Haffner 17 and King 10 using multicolour photometry and Gaia DR2 astrometry. *Mon. Not. Roy. Astron. Soc., 494*, 607-623.

7. Dugrapal, A. Rangwal, G., Bisht, D., Kaur, H., **Yadav, R. K. S.** & **Pandey, J. C.** (2020). A search for variable stars in the four open star clusters. *Jr. Astrophy. Astron., 41*:13 (1-10pp).

8. **Maurya, J.**, **Joshi, Y. C**. & Gour, A. S. (2020). Photometric study of the young open clusters IC 1442, King 21, and Trumpler 7. *Mon. Not. Roy. Astron. Soc., 495,* 2496-2508.

9. Bostroem, K. A., et al. (including **Dastidar, R., Gangopadhyay, A**. & **Misra, K.**) (2020). Discovery and Rapid Follow-up Observations of the Unusual Type II SN 2018ivc in NGC 1068. *Astrophy. Jr., 895*:31 (20pp).

10. Kaur, H., et al. (including **Sharma, S.&Panwar, N**.) (2020). Unveiling the physical conditions in NGC 6910. *Astrophy. Jr., 896:*29 (17pp).

11. **Ojha, V., Chand, H.**, Dewangan, G. C. &Rakshit, S. (2020). A Comparison of X-Ray Photon Indices among the Narrow- and Broad-line Seyfert 1 Galaxies. *Astrophy. Jr., 896:*95 (22pp).

12. **Pandey, Ashwani,** et al. (including **Gupta, A. C.**) (2020). Optical variability of three extreme TeV blazars. *Mon. Not. Roy. Astron. Soc., 496,* 1430-1444.

13. Mannaday, V. K., et al. (including **Joshi, Y. C., Pandey, A. K**. &**Joshi, S.**) (2020). Probing transit timing variation and its possible origin with 12 new transits of TrEs-3b. *Astron. Jr., 160*:47 (15pp).

14. Eswaraiah, C., et al. (including **Pandey, A. K.**) (2020). Unveiling the importantance of magnetic fields in the evolution of dense clumps formed at the waist of bipolar HII regions: a case study of Sh 2-201 with JCMT SCUBA-2/POL-2. *Astrophy. Jr., 897*:90 (19pp).

15. **Pandey, Ashwani** (2020). Nustar view of TeV blazar Mrk 501. Galaxies, 8:55 (12pp).

16. Chatzistergos, T., et al. (including **Banerjee, D.**) (2020). Analysis of full-disc Ca II K spectroheliograms III. Plage area composite series covering 1892-2019. *Astron. &Astrophy., 639,* A88 (1-22pp)**.**

17. Chand, V., et al. (including **Gupta, R., Dimple, Pandey, S. B.& Kumar, Amit**) (2020). Peculiar prompt emission and afterglow in the H.E.S.S.-detected GRB 190829A. *Astrophy. Jr., 898*:42 (13pp).

18. Majumdar, S., Pant, V., **Patel, R.** & **Banerjee, D.** (2020). Connecting 3D evolution of coronal mass ejections to their source regions. *Astrophy. Jr., 899*:6 (15pp).

19. Dewangan, L. K., et al. (including **Sharma, S.** & **Pandey, R.**) (2020). Probing the physical conditions and star formation processes in the galactic H II region S305. *Astrophy. Jr., 898*:172 (16pp).

20. Wani, K. A. & **Gaur, H.** (2020). X-ray Flux and Spectral Variability of Blazar H 2356-309. *Galaxies , 8*, 59(12pp).

21. Mandal, S., Krivova, A., Solanki, S. K., Sinha, N. & **Banerjee, D.** (2020). Sunspot area catalog revisited: daily cross-calibrated areas since 1874. *Astron. &Astrophy., 640,* A78 (12pp).

22. Bisht, D., et al. (including **Yadav, R. K. S.**) (2020). An investigation of poorly studied open cluster NGC 4337 using multicolor photometric and Gaia DR2 astrometric data. *Astron. Jr., 160 :*119 (14pp).

23. Gaur, H. (2020). X-ray spectral evolution of high energy peaked blazars. *Galaxies, 8,* 62 (7pp).

24. Kalita, N., **Gupta, A. C.** & Gu. Minfeng (2020). Temporal and Spectral Variability of OJ 287 before the April–June 2020 Outburst. *Galaxies, 8(3),* 58 (10pp).

25. Gangopadhyay, A., et al. (including **Misra, K., Dastidar, R., Kumar, B., Singh, Mridweeka, Pandey, S. B.** & **Sanwal, P.**) (2020). Optical studies of two stripped-envelope supernovae – SN 2015ap (Type Ib) and SN 2016P (Type Ic). *Mon. Not. Roy. Astron. Soc.,* 497, 3770-3789.

26. Gupta, A. C. (2020). X-ray flux and spectral variability of the TeV Blazars Mrk 421 and PKS 2155-304. *Galaxies, 8,* 64 (15pp).

27. Weaver, Z. R., et al. (including **Dhiman, V.** & **Gupta, A. C.**). (2020). Multiwavelength variability of BL Lacertae measured with high time resolution. *Astrophy. Jr., 900:* 137 (26pp).

28. Kushwaha, P. & Pal, M. (2020). Short-term variability during different activity phases of Blazars S5 0716+714 and PKS 2155-304. *Galaxies, 8,* 66 (12pp).

29. Richichi, A., et al. (including **Sharma, S., Sinha, T., Pandey, R., Ghosh, A.** & **Pandey, A. K.**). (2020). Further milliarcsecond resolution results on cool giants and binary stars from lunar occultations at Devashtal. *Mon. Not. Roy. Astron. Soc., 498,* 2263-2269.

30. Sharma, S., Ghosh, A., Ojha, D. K., **Pandey, R., Sinha, T., Pandey, A. K.**, Ghosh, S. K., **Panwar, N.** & **Pandey, S. B.** (2020). The disintegrating old open cluster Czernik 3. *Mon. Not. Roy. Astron. Soc., 498*, 2309-2322.

31. Mandal, A. K., et al. (including **Pradhan, Bikram**). (2020). Quasar catalogue for the astrometric calibration of the forthcoming ILMT survey. *Jr. of Astrophy. & Astron., 41* : 22 (8pp)

32. Mordvinov, A. V., et al. (including **Banerjee, D.**). (2020). Long-term evolution of the Sun's magnetic field during Cycles 15-19 based on their proxies from Kodaikanal Solar Observatory. *Astrophy. Jr. Lett., 902 :* L15 (6pp).

33. Jaiswal, S. & **Omar, A.** (2020). HI imaging of dwarf star-forming galaxies: masses, morphologies, and gas deficiencies. *Mon. Not. Roy. Astron. Soc., 498,* 4745-4789.

34. Kushwaha, P., Sarkar, A., **Gupta, A. C.**, Tripathi, A. & Wiita, P. J. (2020). A possible gamma-ray quasi-periodic oscillation of ~314 days in the balazar OJ 287. *Mon. Not. Roy. Astron. Soc., 499*, 653-658.

35. Sarkar, A., **Kushwaha, P., Gupta, A. C.**, Chitnis, V. R. & Wiita, P. J. (2020). Multi-waveband quasi-periodic oscillations in the light curves of blazar CTA 102 during its 2016-2017 optical outburst. *Astron.&Astrophy., 642,* A129 (9pp).

36. Joshi, Y. C., John, A. A., Maurya, J., Panchal, A., Kumar, B. & **Joshi, S.** (2020). Variable stars in the field of intermediate-age open cluster NGC 559. *Mon. Not. Roy. Astron. Soc., 499,* 618-630.

37. Bangia, T. & **Uddin, W.** (2020). Development of low-cost cable twister for 3.6m telescope at ARIES. *Jr. Astronomical Instrumentation, 9,* 2050012 (11pp).

38. Sarkar, S., Chattopadhyay, I. & Laurent, P. (2020). Two-temperature solutions and emergent

spectra from relativistic accretion discs around black holes. *Astron.&Astrophy., 642,* A209 (1-21pp).

39. Rodriguez-Ramirez, J. C., **Kushwaha, P.,** de Gouveia Dal Pino, E. M. & Santos-lima, R. (2020). A hadronic emission model for black hole-disc impacts in the blazar OJ 287. *Mon. Not. Roy. Astron. Soc., 498,* 5424-5436.

40. Dewangan, L. K., Ojha, D. K., **Sharma, S.,** del Palacio, S., Bhandari, N. K. & Das, A. (2020). New insights into the HII region G18.88–0.49: hub–filament system and accreting filaments. *Astrophy. Jr., 903*:13 (17pp).

41. Homola, P., et al. (including **Gupta, A. C**.) (2020). Cosmic–ray extremely distributed observatory. *Symmetry, 12,* 1835 (55pp).

42. Anand, R. K., Rastogi, S., **Kumar, B., Ghosh, A., Sharma, S.,** Ojha, D. K. & Ghosh, S. K. (2020). Detection of PAH and nbL features in planetary nebulae NGC 7027 and BD +30° 3639 with TIRCAM2 instrument on 3.6 m DOT. *Jr. Astrophys. Astrno., 41*:27 (11pp).

43. Singh, Sadhana & Pandey, J. C. (2020). Broadband Linear Polarization in the Region of the Open Star Cluster NGC 1817. *Astron. Jr.,* 160:256 (13pp).

44. Sagar, R. (2020). Optical telescopes at Devasthal observatory, Nainital. *Resonance, 25,* 1507-1526.

45. Singh, G., Sahu, S., Subramaniam, A. & **Yadav, R. K. S.** (2020). Peculiarities in the Horizontal Branch Stars of Globular Cluster NGC 1851: Discovery of a Blue Straggler Companion to an EHB Star. *Astrophy. Jr., 905*:44 (16pp).

46. Sagar, R., Kumar, B. & Sharma, S. (2020). Observations with the 3.6-meter Devasthal optical telescope. *Jr. Astrophy. Astron., 41*, 33 (10pp).

47. Panwar, N., et al. (including **Sharma, S.** & **Pandey, R.**) (2020).Star Formation and Evolution of Blister-type HII Region Sh2-112. *Astrophy. Jr., 905*: 61(14pp).

48. Subramaniam, A., **Pandey, Sindhu,** Jadhav, V.V. & Sahu, S. (2020). UVIT/AstroSat studies of blue straggler stars and post-mass transfer systems in star clusters: detection of one more bluelurker in M67. *Jr. Astrophys. Astron., 41*, 45 (7pp).

49. Kasliwal, M. M., et al. (including **Pandey, S. B.**) (2020). Kilonova Luminosity Function Constraints Based on Zwicky Transient Facility Searches for 13 Neutron Star Merger Triggers during O3. *Astrophy. Jr., 905:*145 (31pp).

50. Gangopadhyay, A. et al. (including **Misra, K., Kumar, Brajesh, Singh, Mridweeka, Dastidar, R., Kumar, Brijesh & Pandey, S. B.** (2020). Photometric and spectroscopic evolution of the peculiar Type IIn SN 2012ab. *Mon. Not. Roy. Astron. Soc., 499,* 129-148.

51. Monga, A., Sharma, R., Liu, J., Cid, C., **Uddin, W.,** Chandra, R., & Erdélyi, R. (2021). On the partial eruption of a bifurcated solar filament structure. *Mon. Not. Roy. Astron. Soc., 500,* 684-695.

52. Das, S. R., Jose, J., Samal, M. R., Zhang, S. & **Panwar, N.** (2021). Testing the star formation scaling relations in the clumps of the North American and Pelican nebulae cloud complex. *Mon. Not. Roy. Astron. Soc., 500,* 3123-3141.

53. Ghosh, S., et al. (including **Joshi, S**. & **Lata, S.**) (2021). Fast photometric variability of very low mass stars in IC 348: detection of superflare in an M dwarf. *Mon. Not. Roy. Astron. Soc., 500,* 5106-5116.

54. Yadav, A. P., **Joshi, S.** & Glatzel, W. (2021). Instabilities and pulsations in models of the B-type supergiant k Cassiopeiae (HD 2905). *Mon. Not. Roy. Astron. Soc., 500*, 5515-5523.

55. Sarkar, A., **Gupta, A. C.,** Chitnis, V. R. & Wiita, P. J. (2021). Multiwaveband quasi-periodic oscillation in the blazar 3C 454.3. *Mon. Not. Roy. Astron. Soc., 500,* 50-61.

56. Raiteri, C. M., et al. (including **Gupta, A. C**. & **Dhiman, V**.) (2021). The dual nature of blazar fast variability: space and ground observations of S5 0716+714. *Mon. Not. Roy. Astron. Soc., 501*, 1100-1115.

57. Mandal, A. K., et al. (including **Rakshit, S.**) (2021). Dust reverberation mapping of Z229–15. *Mon. Not. Roy. Astron. Soc., 501,* 3905-3915.

58. Pattnaik, R., et al. (including **Sharma, K.**). (2021). A machine-learning approach for classifying low-mass X-ray binaries based on their compact object nature. *Mon. Not. Roy. Astron. Soc., 501*, 3457-3471.

59. Ojha, V., Chand, Hum & **Gopal-Krishna**. (2021). Intra-night optical variability of γ-ray detected narrow-line Seyfert1 galaxies. *Mon. Not. Roy. Astron. Soc., 501*, 4110-4122.

60. Raychaudhuri, S., Vyas, M. K., & **Chattopadhyay, I.** (2021). Simulations of radiation-driven winds from Keplerian discs. *Mon. Not. Roy. Astron. Soc., 501*, 4850-4860.

61. Tripathi, A., et al. (including **Gupta, A. C**.). (2021). Quasi-periodic oscillations in the long-term radio light curves of the blazar AO 0235+164. *Mon. Not. Roy. Astron. Soc., 501,* 5997-6006.

62. Jha, Bibhuti Kumar, Priyadarshi, Aditya, Mandal, S., Chatterjee, S. & **Banerjee, D.** (2021). Measurements of Solar Differential Rotation Using the Century Long Kodaikanal Sunspot Data. *Solar Physics, 296:* 25 (14 pp).

63. Adassuriya, J. et al. (including **Joshi, S.**). (2021). Asteroseismology of SZ Lyn using multiband high time resolution photometry from ground and space. *Mon. Not. Roy. Astron. Soc., 502*, 541-555.

64. Patel, R., Pant, V., Iyer, P., **Banerjee, D.**, Mierla, M. & West, M. J. (2021). Automated detection of accelerating Solar Eruptions using parabolic hough transform. *Sol. Phys., 296:* 31 (23pp).

65. Samanta, T., et al. (including **Banerjee, D.**) (2021). Plasma Heating Induced by Tadpole-like Downflows in the Flaring Solar Corona. *The Innovation, 2,* 100083 (6pp).

66. Sariya, D. P., Ing-Guey, J., Bisht, D., **Yadav, R. K. S.** & Rangwal, G. (2021). Astrometric and photometric nvestigation of three old age open clusters in the Gaia Era: Berkeley 32, Berkeley 98, and King 23. *Astron. Jr., 161:* 102 (16pp).

67. Sariya, D. P., et al. (including **Yadav, R. K. S.**) (2021). A Comprehensive Analysis of NGC 2158 in the Gaia Era: Photometric Parameters, Apex, and Orbit. *Astron. Jr., 161*:101 (12pp).

68. Hu, Y. -D., et al. (including **Kumar, A., Gupta, R., Pandey, S. B**. & **Aryan, A**.). (2021). 10.4m GTC observations of the nearby VHE-detected GRB 190829A/SN 2019oyw. *Astronomy & Astrophysics, 646,* A50 (9 pp).

69. Singh, Mridweeka, et al. (including **Misra, K., Gangopadhyay, A.& Dastidar, R.**). (2021). The Fast-evolving Type Ib Supernova SN 2015dj in NGC 7371. *Astrophy. Jr., 909:* 100 (12pp).

70. Xu, Yan, et al. (including **Banerjee, D.**). (2021). Migration of Solar Polar crown filaments in the past 100 years. *Astrophy. Jr., 909:* 86 (8pp).

71. Zhang, Z., et al. (including **Gupta, A. C**. & **Gaur, H**.) (2021). X-Ray Intraday Variability of the TeV Blazar PKS 2155–304 with Suzaku during 2005–2014. *Astrophy. Jr., 909:*103 (13pp).

72. Rakshit, S., Stalin, C. S., Kotilainen, J. & Shin, J. (2021). High-redshift narrow-line Seyfert 1 galaxies: a candidate sample. *Astrophy. Jr. Supl. Sr., 253:* 28 (10pp).

73. Fu, Zhen-Xing, et al. (including **Pradhan, B., Singh, M**. & **Misra, K**.) (2021). Interacting system NGC 7805/6 (Arp 112) and its tidal dwarf galaxy candidate. *Research in Astronomy and Astrophysics, 21,* 43 (8pp).

Atmospheric Sciences

1. Dumka, U. C., et al. (2020). Long-term (2008-2018) aerosol properties and radiative effect at high-altitutde sites over western trans-himalayas. *Science of the Total Environment, 734*, 139354 (1-20pp).

2. Jaiswal, A., Phanikumar, D. V., Bhattacharjee, S. & **Naja, M.** (2020). Estimation of turbulence parameters using ARIES ST Radar and GPS radiosonde measurements: first results from the Central Himalayan region. *Radio Science, 55,* e2019RS006979 (18pp).

3. Sharma, S. K., et. al. (including **Srivastava, Priyanka** & **Naja, M.**). (2020). Variation of carbonaceous species and trace elements in PM_{10} at a mountain site in the central Himalayan region of India. *Jr. Atmos. Chemis., 77*, 49-62.

4. Dhaka, S. K., et al. (including **Singh, N.**). (2020). $PM_{2.5}$ diminution and haze events over Delhi during the COVID 19 lockdown period: an interplay between the baseline pollution and meteorology. *Nature Scientific Report, 10:* 13442(8pp).

5. Pandey, C. P., **Singh, Jaydeep**, Sonic, V. K. & **Singh, N.** (2020). Yearlong first measurements of black carbon in the western Indian Himalaya: Influences of meteorology and fire emissions. *Atmos. Pollu. Res., 11,* 1199-1210.

6. Ojha, N., et al. (including **Singh, N.**). (2020). On the widespread enhancement in fine particulate matter across the Indo-Gangetic Plain towards winter. *Nature Scientific Report, 10:* 5862 (11pp).

7. **Rawat, P.,** et al. (including **Naja, M.** & **Bhattacharjee, S.**) (2020). Assessment of vertical ozone profiles from INSAT-3D sounder over the Central Himalaya. *Current Science, 119,* 1113-1122.

8. Archibald, A. T., et al. (including **Naja, M.**) (2020). Tropospheric Ozone Assessment Report: A critical review of changes in the tropospheric ozone burden and budget from 1850 to 2100. *Elementa: Science of the Anthropocene*, *8 (1):* 034 (1-53pp).

9. Hanumanthu, S., et al. (including **Naja, M.**) (2020). Strong day-to-day variability of the Asian Tropopause Aerosol Layer (ATAL) in August 2016 at the Himalayan foothills. *Atmos. Chem. Phys., 20*, 14273-14302.

10. **Dumka, U. C.**, Kaskaoutis, D. G., Mihalopoulos, N. & **Sheoran, R.** (2021). Identification of key aerosol types and mixing states in the central Indian Himalayas during the GVAX campaign: the role of particle size in aerosol classification. *Science of the Total Environment, 761,* 143188.

11. **Shukla, K. K., Phanikumar, D. V.**, Kumar, K. N., **Kumar, Ashish, Naja, M.,** Sharma, Som& Attada, R. (2021). Micro-Pulse Lidar observations of elevated aerosol layers over the Himalayan region. *Jr. of Atmospheric and Solar-Terrestrial Physics, 213*, 105526 (11pp.).

12. Kaskaoutis, D. G., et al. (including **Dumka, U. C.**) (2021). In situ identification of aerosol types in Athens, Greece, based on long-term optical and on online chemical characterization. *Atmospheric Environment, 246,* 118070 (18pp).

13. Jorge, T., et al. (including **Naja, M.**). (2021). Understanding balloon-borne frost point hygrometer measurements after contamination by mixed-phase clouds. *Atmos. Meas. Tech., 14,* 239–268.

14. Kumar, A., et al. (including **Singh, N.**). (2021). Assessment of carbonaceous fractions in ambient aerosols at high altitude and lowland urban locations of Kumaon Province, Indian Himalaya. *SN Applied Sciences, 3:* 83 (14pp).

15. Mehta, M., Khushboo, R., Raj, R. & **Singh, N.** (2021). Spaceborne observations of aerosol vertical distribution over Indian mainland (2009–2018). *Atmos. Envir., 244,* 117902 (13pp).

16. **Dumka, U. C.** et al. (2021). Silver linings in the dark clouds of COVID-19: Improvement of air quality over India and Delhi metropolitan area from measurements and WRF-CHIMERE model simulations. *Atmos. Pollution Res., 12,* 225-242.

17. Kaskaoutis, D. G., et al. (including **Dumka, U. C**.) (2021). Assessment of the COVID-19 lockdown effects on spectral aerosol scattering and absorption properties in Athens, Greece. *Atmosphere, 12,* 231 (24pp).

18. **Singh, J.** & **Singh, N.,** et al. (2021). Effects of spatial resolution on WRF v3.8.1 simulated meteorology over the central Himalaya. *Geoscientific Model Development, 14,* 1427-1443.

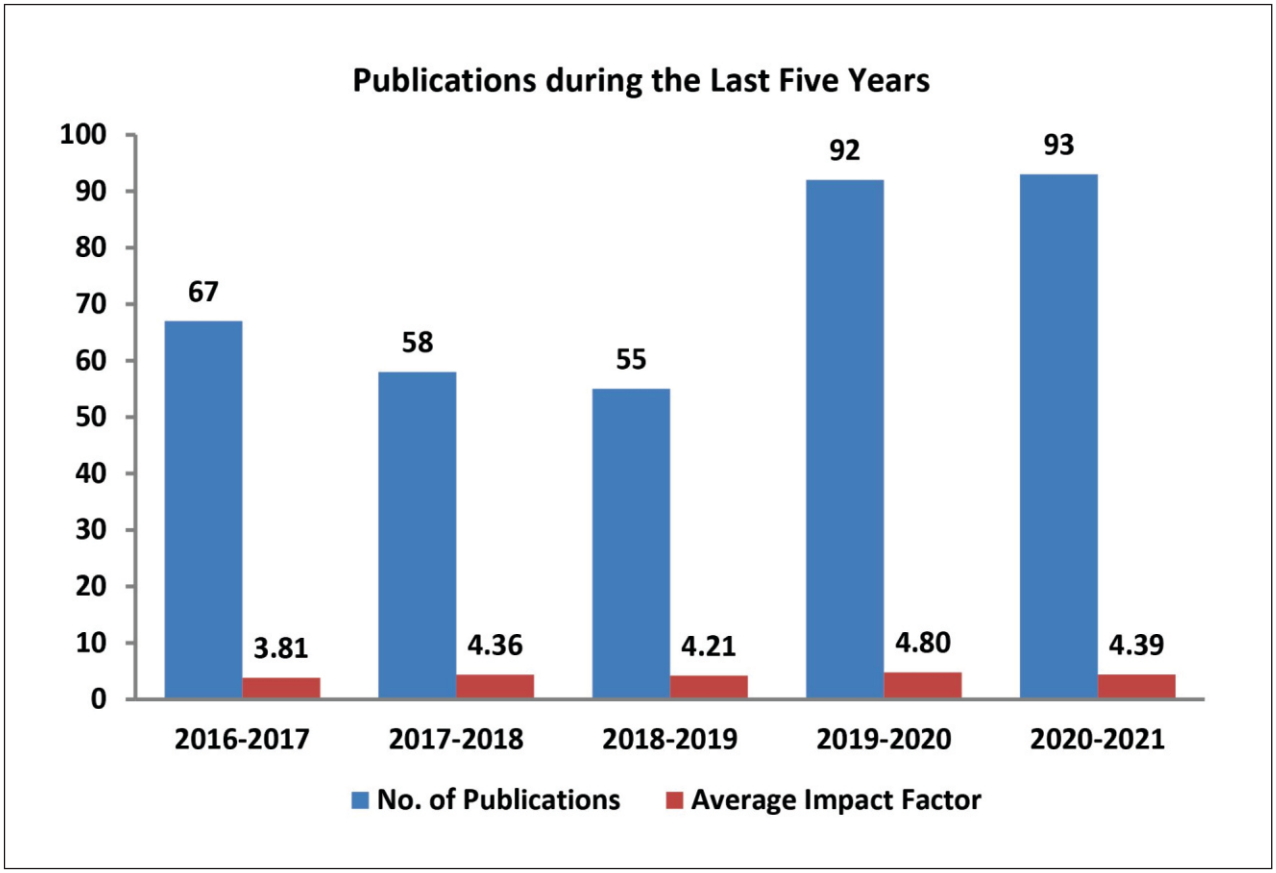
19. Gogoi, M. M., et al. (including **Naja, M**.) (2021). Response of ambient BC concentration across the Indian region to the nation-wide lockdown: results from the ARFINET measurements of ISRO-GBP. *Current Science, 120,* 341-351.

20. Srivastava, P. & Naja, M. (2021). Characteristics of carbonaceous aerosols derived from long-term high-resolution measurements at a high-altitude site in the central Himalayas: radiative forcing estimates and role of meteorology and biomass burning. *Environ. Sci. Pollut. Res., 28*, 14654–14670.

Conference Proceedings/Circulars

1. **Bangia, T. & Uddin, W.** (2020). Sustaining mechanical systems of 3.6-m optical telescope at Devasthal, India. *Proc. of SPIE, 11445*, 1144520-1-14.

2. Several Gamma Ray Burst Circular Network (GCN) circulars.



International and National Research Projects

In the year 2020-21, the following externally funded research projects were in progress.

Name of Project: Observational signature of super massive Black Holes: TeV blazars in multi-wavelength view.
PI (ARIES): Alok C. Gupta
PI of the collaborating institute: M. Ostrowski, Astronomical Observatory, Jagiellonian Univ., Krakow, Poland
Funding Agency: DST, Govt. of India
Project Code: DST/INT/POL/P–19/2016

Name of Project: Indo-Thai collaboration for Studying Pulsating Variables at Different Evolutionary Stages.
Co-PI (ARIES): Santosh Joshi
PI of the Collaborating institute: Aruna Goswami, IIA, Bangalore and David Mkrtichian, NARIT, Thailand
Funding Agency: DST, Govt. of India
Project Code: DST/INT/Thai/P-16/2019

Name of Project: Influence of massive stars on the formation and evolution of low mass stars.
PI (ARIES): Saurabh
PI of the Collaborating institute: Ramkesh Yadav, NARIT, Thailand
Funding Agency: DST, Govt. of India
Project Code: DST/INT/Thai/P-15/2019

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

Title of Project: Belgo-Indian Network for Astronomy and Astrophysics (BINA).
PI (ARIES): Santosh Joshi
PI of the collaborating institute: Peter De Cat, Belgium
Funding Agency: DST, Govt. of India
Project Code: DST/INT/Belg/P-02/2014

Name of Project: Flares from F to M-type mass stars.
PI (ARIES): Jeewan C. Pandey
PI of the collaborating institute: Igor S. Savanov, Institute of Astronomy, Moscow, Russia
Funding Agency: DST, Govt. of India
Project Code: INT/RUS/RFBR/P-271

Title of Project: Probing of Hot Jupiters Environmental and Physical Conditions: Numerical Modeling vs Observations.
PI (ARIES): Yogesh C. Joshi
PI of the collaborating institute: Navin Dwivedi, Space Research Institute, Graz, Austria
Funding Agency: DST, Govt. of India
Project Code: INT/AUSTRIA/BMWF/P-14

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

Title of the 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

Title of the 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

Title 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.

Title 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.

Title 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

Title of Project: Devasthal Optical Telescope - AGN Reverberation Monitoring (DOT-ARM): Probing AGN black-hole masses and broad line regions.
PI (ARIES): Hum Chand
Co-PI (ARIES): Amitesh Omar
Funding Agency: DST/SERB

Highlights from Engineering Division

For economic and efficient utilisation of the engineering resources all laboratories, skill sets and tools under the engineering division are available as a common pool of resources and the engineering activities are centrally managed as a mutli-disciplinary group. All the sections have setup in common area/laboratories for shared access of the available design and development tools like software, hardware etc.

To efficiently execute the engineering and maintenance activities, the engineering groups have been restructured and laboratories are centralized. The tasks are handled in project or mission mode and members are dynamically attached based on their availability and skill sets. This provides them an opportunity to participate in different project and enhance their skills and versatility. Each of the senior members handle a larger responsibility like managing the overall site activities, planning the preventive maintenance of overall facilities, managing the overall project, work of system engineering etc.

Electronics/Electrical Section

The electronics laboratory has been restructured and upgraded to cater to design, development and maintenance of the telescopes, backend instrument and other facilities at ARIES.

1) Electronics laboratory for telescopes

The laboratory (**Figure 23**) for telescopes is electro-statically safe and humidity controlled. It is equipped with all the necessary tools and development platform required to work on the electronics aspects of telescopes and instruments at ARIES. Thus, the engineers are able to effectively utilise the central electronics laboratory facility for most of their projects, better interaction and exchange of knowledge.

Figure 23. ARIES Electronics laboratory for telescopes.

2) Measurement and testing tools

The laboratory is equipped with sophisticated tools like digital storage oscilloscopes with protocol decoders, precision benchtop multimeter, programmable power supply, arbitrary function generator etc. with PC based control which help the engineers in development and maintenance activities. A precision LCR meter for regularly characterising the critical components of telescopes including the motors and a capacitive measurement tool for installation and alignment of the precision open frame encoders were procured this year.

3) Design and development platform

The laboratory is equipped with simulation and HIL emulation platform for helping the engineers during the design and validation phase (**Figure 24**). Embedded platform based on Microchip microcontrollers is available for final implementation. Most of the development work is done in-house and SMD station is available for developing the electronics boards. Low cost microcontroller and PLD based embedded boards by Microchip, Texas Instruments and Cypress Semi-conductors were procured this year for efficiently

Figure 24. Engineers evaluating different control techniques for the DOT motion control by utilizing the design and development platform and measuring tools

developing instrument controllers. Solidworks electrical software was procured for developing and updating the electrical schematic diagrams of the telescopes. Orcad software was made available as a common facility in this laboratory for designing the PCBs.

4) DOT spares

Most of the telescope spares are available in this laboratory including the critical spares of the DOT. Two test control panels (**Figure 25**) have been developed for periodically energising, understanding and configuring the spares like motion controller, PLCs, programmable drives, BLDC motors etc.

Figure 25. Engineering team members learning on the DOT simulation setup.

5) Integrated development

The laboratory also supports interdisciplinary engineering activities for an integrated development of systems and subsystems, for example:

a. Software platform including Labview, Visual Studio, Matlab, QT etc. are available for developing machine interface software for various hardware platforms used in telescopes and instruments. Protocol testing tools, target boards and test rigs with sensors and actuators are available for testing the software.

b. Linear and rotary stages are available for evaluating the telescope electro-mechanical interfaces or mechatronics aspects. The laboratory is equipped with Solidworks CAD software for developing the interfaces and studying and modifying the drawings.

c. A dedicated area with vibration free bench is available for opto-electronics work like alignment of CCD fore-optics, characterization and calibration of CCDs (**Figure 26**), alignment and testing of precision encoders, testing wavefront sensors and auto guider systems etc.

Figure 26. ARIES students utilizing the training area and interdisciplinary facilities in the laboratory for learning and characterizing a 4k×4k CCD camera.

6) Training

A dedicated area has been developed for imparting training to the engineers and technical staff members where bench top training tools are explored and evaluated with the help from online trainers from industries.

7) Planned upgrades

a. Setup to test active optics of the DOT and development of profiler instruments for Devasthal site.

b. FPGA platform for CCD controllers and deformable mirrors.

c. Motion controller platform suitable for upgrading the 1.3m telescope using in-house and in-country efforts.

d. Matlab education licensing for research and instrumentation work.

e. GPU platform for application of AI in astronomy and atmospheric sciences.

Participation in networked projects

The electronics engineers are currently participating in **a.** TMT WOFS electronics development; **b.** *INSIST* project; **c.** Development of small observatory for studying space debris in collaboration with ISRO.

Mechanical Engineering Section

To fulfill the stringent requirements in instrumentation research and development, a fairly well-equipped mechanical section has been established.

The mechanical section is equipped with a vertical machining center CNC and conventional machines such as lathe, milling, radial drilling, surface grinder, mechanical power hacksaw, tool grinder, air compressor, single-phase, three-phase machines, TIG welding machines, etc. Besides, a portable CMM machine is equipped for measuring the geometry of physical objects by sensing discrete points on the surface of the object with a probe.

The engineers are familiar in Pro E, Unigraphics, Auto Cad, Ansys, and Master cam software for design simulation and computer-aided manufacturing of critical mechanical systems.

1) Design of side port imager for 3.6m DOT

The 3.6m DOT has a provision for installing instruments on the axial port and side port. To accommodate a side port instrument, design work was carried out considering the feasability (availability of space to mount the instrument) and scientific requirement. The final instrument envelope size is approximately 500×380×820mm with a weight of 250 kg. Brief details of the instrument design are:

a. Side port imager assembly envelope

The side port imager consists of a strong rigid filter housing structure, filter wheel and its mechanism, and index CCD mounting mechanism to quickly point two different cameras. The centre of gravity and the optical plane are maintained as required (**Figure 27**).

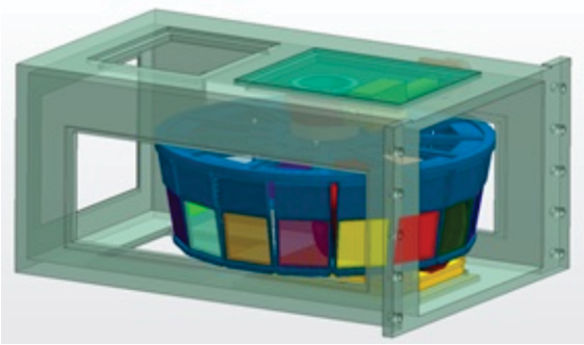


Figure 27. Side port imager assembly envelope.

b. Filter wheel and its mechanism

The filter wheel assembly consists of the wheel drive assembly, bearing housing, worm gear and stepper motor. The precisely manufactured worm and pinion gears rotate the filter wheel through a stepper motor and a controller mounted on the filter housing. Total 16 SDSS/broadband filters of size 90×90mm can be accommodated in the filter wheel (wheel size of approximately 600 mm diameter). The total mass of the entire unit is around 25 kg (**Figure 28**).

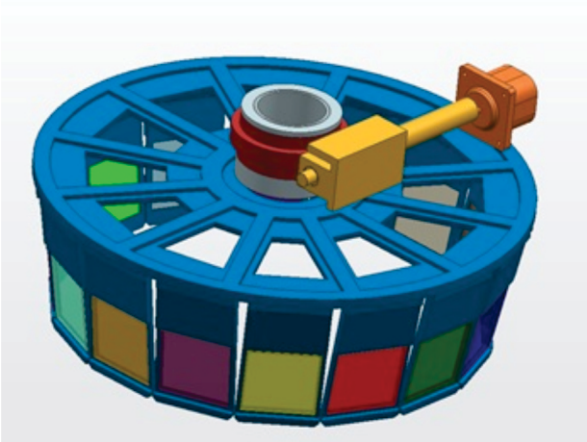


Figure 28. Filter wheel.

c. Indexing camera mount

A new type of camera mount was designed for indexing two cameras at a time depending upon the scientific requirement and saving time involved in mounting and dismounting (**Figure 29**).

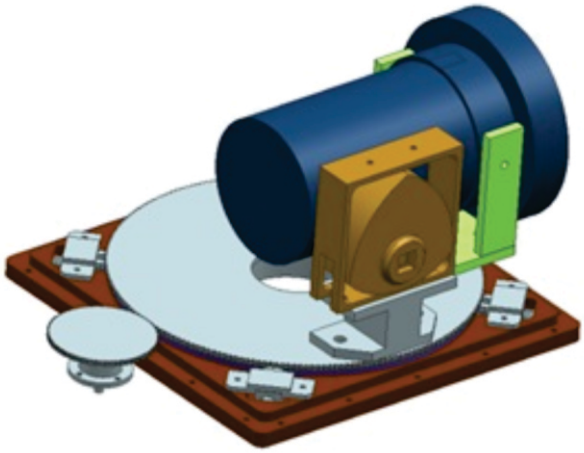


Figure 29. Camera mount.

2) The pick off mirror (POM) and fold pick off mirror (FPOM) mirror coating required the AGU camera (in DOT) to be dismounted (before coating) and mounted (after coating). This exercise was successfully executed. The bracket designs to accommodate the new upgraded camera were modified as required.

3) A new cylindrical baffle was designed and fabricated to avoid the light leakage in 4k×4k *IMAGER*.

4) Laser alignment unit for 1.3m DFOT was designed and accurately machined and assembled for secondary mirror fine alignment.

5) *TANSPEC* instrument dewar was carefully opened to replace the damaged bearing.

6) The mirror cover and mirror cell assemblies were dismounted from the 1.04m ST telescope tube for aluminising. After aluminising, the mirror was aligned back in the mirror cell and lifted for mounting on the telescope. The issue of focus mechanism gearbox was rectified.

Optics section

The optics section caters to design, development, upgradation and maintenance related to optical components of different facilities. Maintenance and health run of coating plants are also routinely carried out.

1) Coating and alignment

Aluminum coating in POM and FPOM of 3.6m DOT was performed to improve the reflectivity. The preparation and setup before removing the mirrors were undertaken with extreme care. Upon final coating, the reflectivity was measured (**Figure 30**) and the mirrors were integrated with the guider unit of the telescope and realigned. On sky observations were used for achieving the final alignment. Pointing models were generated after the alignment and wavefront errors were checked using Zernike polynomials of wavefront sensor.

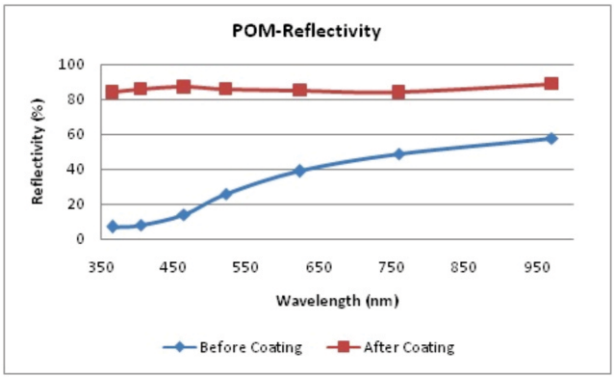


Figure 30. POM reflectivity comparison before and after coating.

The cleaning of 1.3m DFOT primary mirror was done with Labdet soap solution and distilled water which improved the reflectivity upto 80% toward bluer end and 89% toward redder end (**Figure 31**). The corrector and filters were also cleaned to remove dust. The exercise of optical alignment of the telescope resulted in an improved image quality. The images obtained were circular throughout the frame in all filters and no significant variation was observed in psf FWHM from one end to the other, both in x- and y-directions along the CCD chip. An image of the stellar field BD+284287 taken after the optical alignment is shown in **Figure 32.**

Primary mirror of 1.04m ST was removed from the telescope for cleaning and recoating during August-

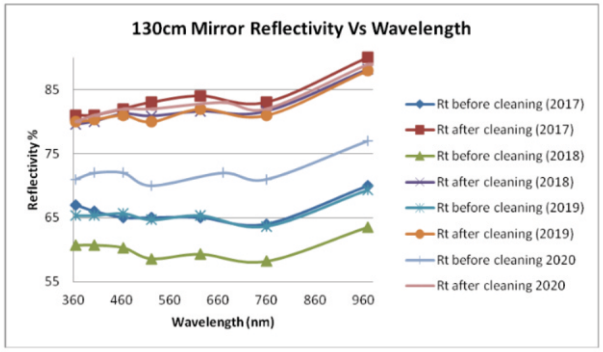


Figure 31. Reflectivity log of 1.3m DFOT primary mirror.

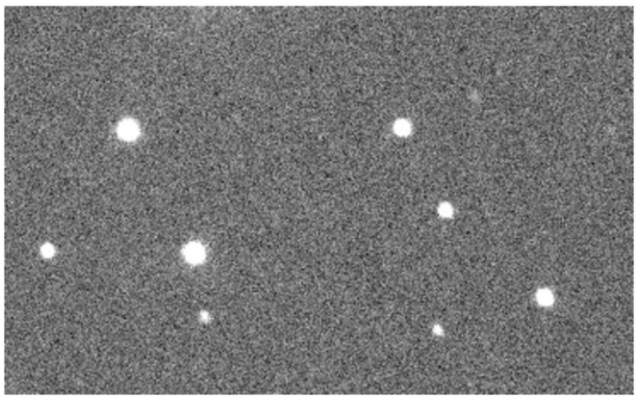


Figure 32. Image of the field BD+284287 taken after the optical alignment of 1.3m DFOT.

September, 2020. The freshly coated mirror, with an improved reflectivity between 10-15%, was assembled and mounted on the telescope and the final alignment was achieved.

The 3.6m DOT coating plant was also used for coating of 41 concave optical blanks for TACTIC gamma ray telescope of BARC.

The telescope optics and laser optics in LiDAR were aligned after cleaning of the components. The reflectivity of secondary fold mirror and the transmission of interference filter were measured. Total efficiency of LiDAR was estimated. An arrangement was made to block the unwanted light during testing. After successful alignment, the laser was switched on in low power mode. With the present setup, LiDAR responded to atmospheric/clouds signals upto 10 km.

2) Backend Instruments of 3.6m DOT

Routine activities like evacuation of dewar, cooling, Helium, power lines routing and mounting/unmounting of instruments on DOT were performed whenever required along with focus checks and pointing model generation.

The optical components like filters, grisms and prisms were disassembled from the filter wheels of *IMAGER* and *AD-FOSC* for a thorough cleaning. Transmission measurement of optical filters was carried out. The slits were also cleaned and slit widths were measured using optical profiler. An optical substrate for calibration unit of *AD-FOSC* was prepared and coated on both sides of the glass plate. The beam size evaluation in Zemax software was done to design a baffle for *IMAGER,* which was required to resolve the issue of stray light.

Grating replacement was done in *TANSPEC*. Small apertures were installed in calibration lamp unit to use the full dynamic range for all wavelengths to avoid saturation in both low and high dispersion modes. Ghost analysis for *TANSPEC* to check unwanted source images within the dome was performed. In *TIRCAM2,* Helium was refilled in the compressor and any leakage issues were tested and resolved in the helium lines.

3) Planned future activities

Compound non deviating prism for *AD-FOSC*: Three compound non deviating prisms have been designed for slit less low resolution spectroscopy (**Figure 33**). The optical materials and prism angles have been designed as per spectral/dispersion and wavelength requirements. The sizes (diameters and thickness) of the prisms were optimized to fit in the existing grism wheel of *AD-FOSC*.

Volume Phase Grating (VPH) for *AD-FOSC*: To meet the high resolution requirements considering efficiencies, VPH grisms have been designed for different wavelengths to achieve resolving powers ranging from R~5000-10000 (**Figure 34**). Four VPH grism designs have been developed with high refractive index materials (ZnSe and N-SF66) and vertex angles such that they can fit (VPH grism size 55×55mm) into the existing *AD-FOSC* grism wheel slots. Two B270i glasses, each of thickness 1.5mm, were used for the VPH grating and then sandwiched between two ZnSe/N-SF66 prisms of different vertex angles to maintain the beam undeviated at central wavelengths. Due to high refractive index glasses, there may be some reduction in the overall transmission of the system.

Optical profiler for 3.6m DOT: A new instrument is being planned to estimate high sensitivity vertical

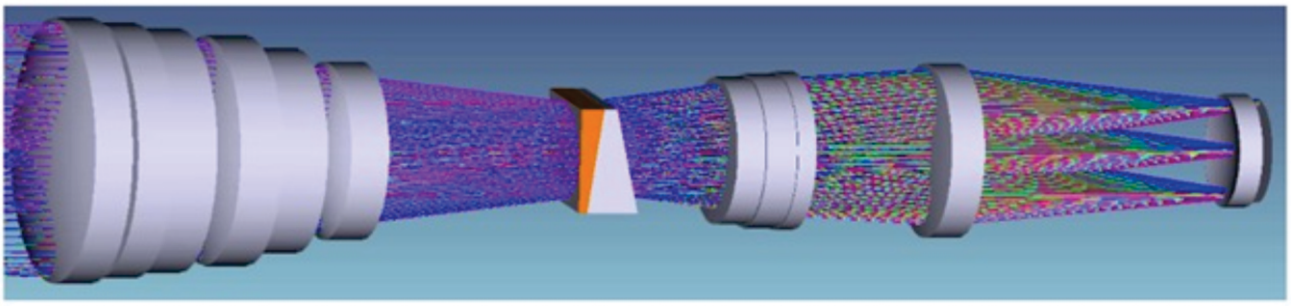


Figure 33. Zemax design of *AD-FOSC* optics with compound non deviating prism.

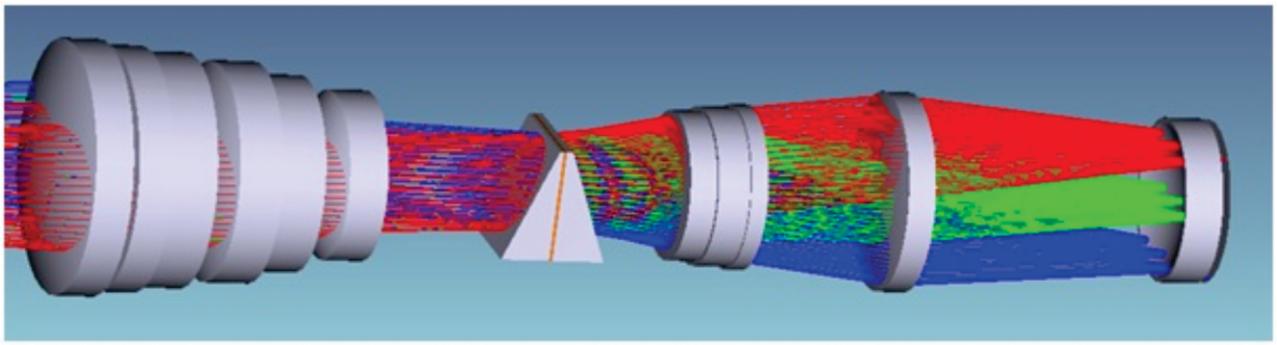


Figure 34. Zemax design of *AD-FOSC* optics with VPH grating.

profiles of the atmospheric optical turbulence and wind velocity profile above Devasthal site. This is based on the Stereo–SCIntillation Detection And Ranging (SCIDAR) approach, which uses a stereoscopic system with the scintillation pattern from each star of a double-star target incident on a separate detector. At present, a setup has been arranged in optics laboratory using existing components to realise the concept and prepare a preliminary design for DOT, which in future will be achieved with required optical and opto-mechanical components.

Computer Section

The computer section caters to the computing requirements of the institute. The primary goals of the section are (i) IT security, network datacenter management, (ii) application software, emails, web management and support, (iii) necessary support to research facilities, (iv) maintenance and upgradation of IT resources, (v) timely user support and (vi) necessary planning and procurement. The management strategy adopted by the computer section is displayed below (**Figure 35**).

Feature	Description
Unlimited Support	✓ Preventive maintenance plan on servers, workstations, and all network devices ✓ Response to any network issues that arises ✓ Asset, license and warranty management ✓ Website related works ✓ Emergency rapid response & after hours availability
Advanced Security Management	✓ Firewall management ✓ Security policy creation and enforcement ✓ Wireless and remote user security management ✓ Other security & surveillance services
Storage & Recovery Management	✓ Backup management ✓ Data recovery
Desktop/Laptop Management	✓ Optimal configuration ✓ Preventive maintenance ✓ Performance monitoring ✓ Application compliance & response to issues

Figure 35. Management strategy adopted by the computer section.

Tasks accomplished/involvements

(i) Strengthening of internet with a new 100 Mbps ILL. LAN, Wi-Fi and OFC connectivity at Manora Peak/Devasthal office and campus.

(ii) Consolidation and centralised management of existing IT assets like servers, storage and network resources and database maintenance & administration.

(iii) Providing high level of confidentiality and IT security for users.

(iv) Centralized high-end computing facility accessible for ARIES users (account based).

(v) Network monitoring, planning, management, and upgradation.

(vi) SSL procurement & management, software license management, email and VPN services to users.

(vii) Strengthening of the audio-visual services, conferencing devices, digital video repository etc.

(viii) Joint-partnership with IIT Bombay in their spoken-tutorial program on Free Open Source Software (FOSS) learning for ARIES users.

(ix) Management of CCTV network comprising of large number of IP-based dome & bullet cameras, outdoor as well as indoor, to cover strategic points and remote locations.

(x) Involvement in major R&D projects of the institute: (a) involvement in data collection, storage, distribution, migration, instrument logs etc., (b) providing stable network connections to the facilities, (c) software development, installation and setup, (d) troubleshooting and rectification of hardware etc.

(xi) Outreach activities: Handling social media platforms of ARIES, providing support in live streaming of events via social media, recording and processing of sessions of seminar/colloquia and processing of night sky events images.

(xii) Support to administration in uploading tenders, advertisements, news & updates, etc.

Key achievements

1) Migration of E-mail services to National Informatics Centre (NIC)

ARIES email services were migrated to NIC which has enhanced security, performance and larger mail boxes (**Figure 36**).

Figure 36. Migration of old email server (top) to new NIC email server (bottom).

2) Implementation of Enterprise Resource Planning (ERP)

The implementation of ERP solutions for the institute's workflow was planned and is at development stage at present. As a part of digitisation, several in-house software(s), including webforms and databases, were also developed and deployed.

3) High Performance Computing (HPC) facility

The rising demand of high computational resources has elevated the priority to establish HPC facilities in the institute. A rigorous exercise was done for procurement and installation of GPU and CPU based HPC facilities at ARIES data center.

4) Redesigning of ARIES website

Institute website www.aries.res.in was redesigned on CMS based Drupal platform with an improved look and feel to meet the statutory guidelines by the Government for websites. The salient features are multiple editors/users, easy to manage, user-friendly, safe and secure, less backend coding etc. (**Figure 37**).

Figure 37. Redesigned website of ARIES with CMS based Drupal platform.

Reports from Existing Observing Facilities

3.6m Devasthal Oprical Telescope (DOT)

ARIES operate India's largest 3.6m Devasthal Optical Telescope (DOT) in optical and near-infrared wavelengths as a national facility and host 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 an average, the night sky was fully clear for about sixty percent of the time during April, 2020 to March, 2021 excluding the monsoon period.

The four core teams for the overall functioning and management of DOT are (i) DOT team executing day-to-day operation, maintenance and upgradation activities; (ii) instrument team accountable for the overall management of existing instruments (*IMAGER, TIRCAM2, TANSPEC* and *AD-FOSC*) and development of upcoming instruments; (iii) DOT Operation, Maintenance and Upgradation (DOMU) Committee to review the operation, maintenance and upgradation of both telescope and backend instruments and advise ARIES on matters of concern; (iv) DOT Time Allotment Committee (D-TAC) responsible for observing time allocation based on scientific merits of the proposal.

The scientific activities performed are summarised below.

1) Observing period from April to May 2020

IMAGER and *AD-FOSC* were mounted on the telescope during April-May, 2020. Various instrument verification tests (IVT) and science observations were performed. For the first time the functioning of *TIRCAM2* on the side-port1 with another main port instrument was successfully tested and operated. **Figures 38** and **39**

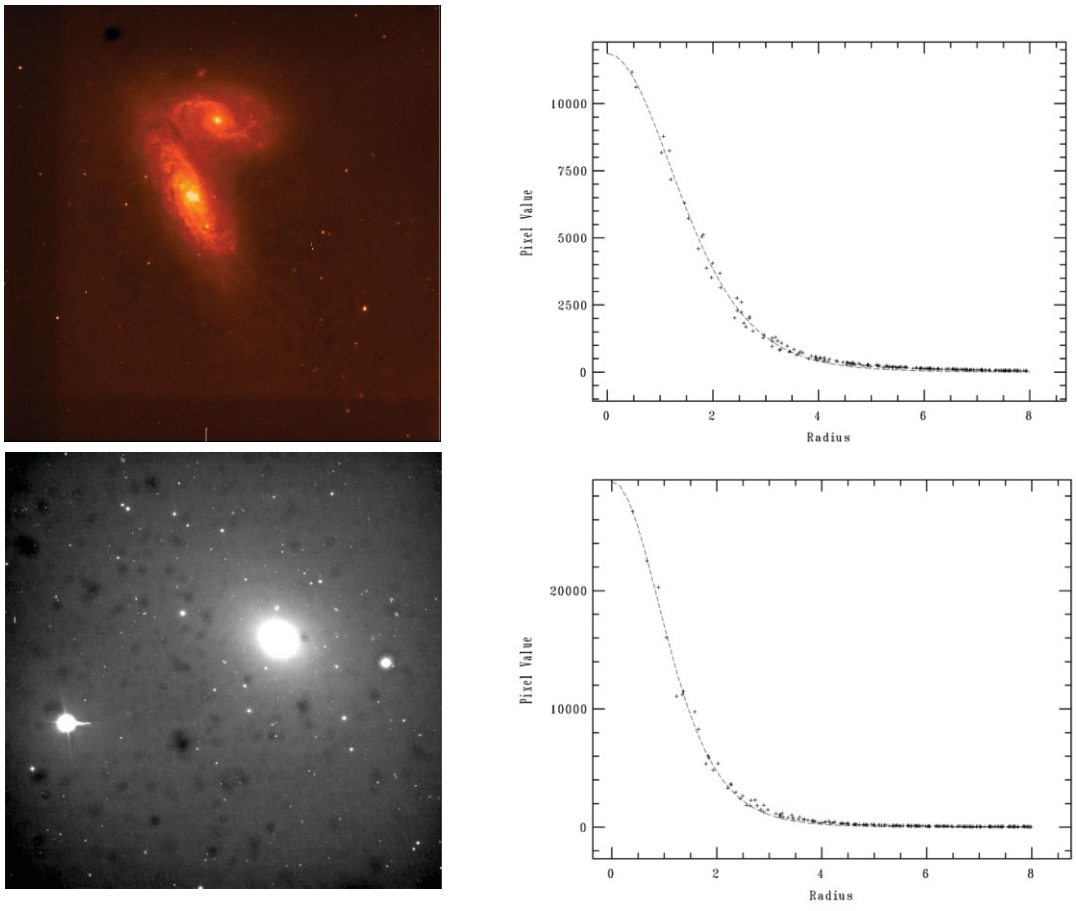


Figure 38. Top picture: I-band 20s image of SN 2020fqv, hosted in NGC 4568 which is a double galaxy (NGC 4567/68), observed with *IMAGER* on 15/16 April, 2020. Top right: PSF FWHM of stellar profile of 2.9 pixels, i.e 0.5 arcsec. Bottom: SDSS r-band 30s image of galaxy NGC 4636 hosting SN 2020ue observed with *AD-FOSC* on 27/28 May 2020. Bottom right: PSF FWHM of stellar profile is 0.92 arcsec.

show typical images obtained from this observing run. This proved helpful in planning the observing cycle DOT-2020-C2 from October, 2020 to January, 2021.

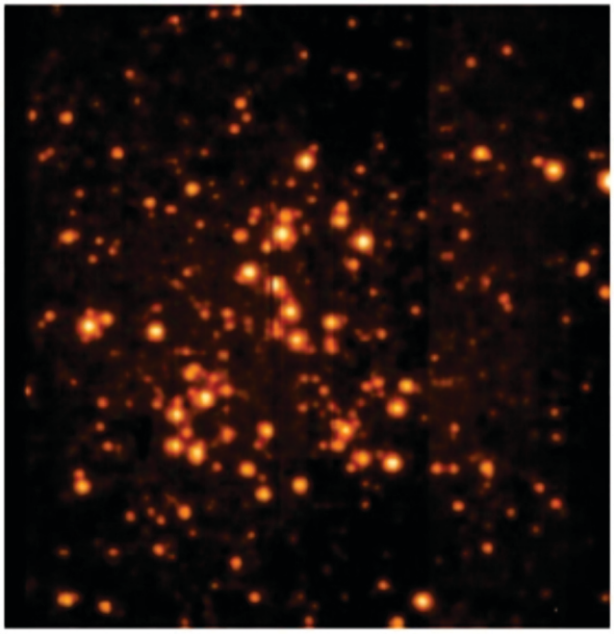


Figure 39. J-band image of globular cluster M53 observed with *TIRCAM2* mounted on side-port1. PSF FWHM is about 0.8 arcsec.

2) Non-observing monsoon period

During the monsoon period at Devasthal from June-September, 2020, the telescope was parked and protected from rain and high humidity. Regular maintenance and upgradation activities on the telescope were also done. A few parts of the telescope viz., azimuth, altitude, rotator, adapter, sensor arm focus and turntable, M2 hexapod, and M1 mirror were moved fortnightly to keep the telescope in good health.

3) Observing cycle DOT-2020-C2 (October to January)

As a follow-up of the recommendation of DOMU meeting, the upgrade of existing DOPSES - online proposal submission and evaluation system of DOT was taken up in collaboration with IIA and the same was deployed (front end shown in **figure 40**) on ARIES webserver and email services (dopses@aries.res.in). DOPSES presently has 392 registered users from 6 different countries, including almost 200 Ph. D. students and more than 50 PDFs.

Call for Proposals: The call for observing proposals for cycle 2020C2 was opened in July, 2020 to the

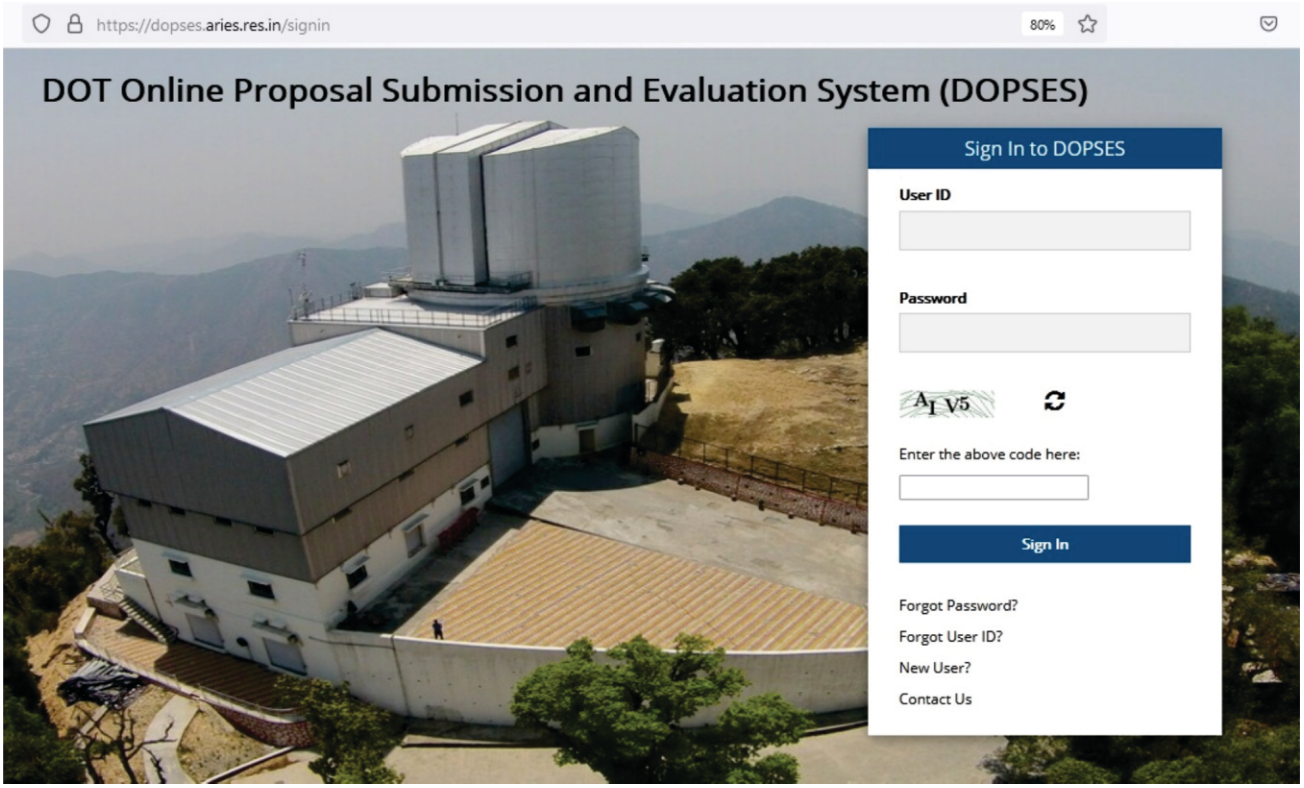


Figure 40. Frontend of DOPSES deployed at ARIES webserver.

astronomical community of India with a proposal submission deadline of 01 August, 2020. Three instruments were offered on the main-port and one instrument on side-port1. Detailed computation of the available time for science users was made by the DOT team. Considering the COVID restrictions, it was decided that all observations will be done by ARIES in service mode.

Scheduling: Total 97 proposals were submitted via DOPSES by astronomers from India and Belgium. The over subscription factor for telescope time was around three. The time allocation on the proposals recommended by DTAC was scheduled by the DOT team in consultation with the instrument team. Appropriate time was structured for Instrument Change Time (ICT), Director's Discretionary Time (DDT), Telescope Maintenance Time (TMT) and Instrument Verification Time (IVT). 10% of DDT time was allocated for one hour every night. On the main axial-port, the *IMAGER* was mounted during 1-16 October (16 nights), *TANSPEC* during 17 October-30 November (45 nights), *AD-FOSC* during 1 December, 2020 - 15 January, 2021 (46 nights) and *IMAGER* again during 16-31 January, 2021 (16 nights). **Figure 41** depicts various statistics summarising 2020-C2. Overall, the 2020-C2 observations were performed successfully with a technical downtime of less than five percent.

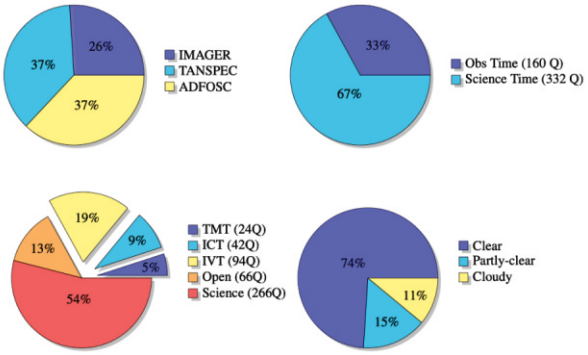


Figure 41. Statistics for mounting of main port instruments, availability of time and DTAC-approved allocation and clear sky statistics for cycle DOT-2020-C2.

4) Observing cycle DOT-2021-C1 (February to May)

Call for Proposals: The call for observing proposals for cycle 2021C1 was opened in November, 2020 with a proposal submission deadline of 01 December, 2020. The four available instruments were offered for observations and a tentative sequence of the instruments was communicated to the proposers.

Scheduling: Total 75 proposals were submitted for cycle 2021-C1 with an over subscription factor of 1.9 for science proposals. After evaluation and recommendation of time for proposals by DTAC, a detailed schedule was prepared by the DOT team in consultation with the instrument team. DDT in quarters was allotted in contrast to 1 hour allocation every night for cycle 2020-C2. With regard to Target of Opportunity (ToO) observations and its compensation, a modified science observing policy was prepared and implemented. On the main-port, the *IMAGER* was mounted during 1-7 February (7 nights), *AD-FOSC* during 8 February - 24 March (45 nights) and AGU Guider during 25-31 March (6 nights). **Figure 42** depicts various statistics summarising 2021-C1. Overall, the 2021-C1 observations were performed successfully with a technical downtime of less than five percent.

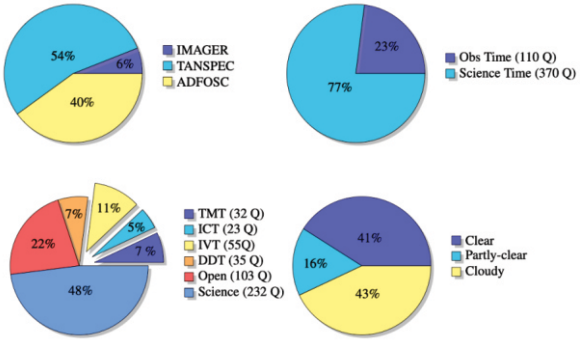


Figure 42. Statistics for mounting of main port instruments, availability of time and DTAC-approved allocation and clear sky statistics for cycle DOT-2021-C1.

5) Major repair of Auto Guiding Unit (AGU)

The sensitivity of the AGU of the telescope depends largely on the reflectivity values of POM and FPOM. Over the years the reflectivity degraded at a much faster rate than expected. It was decided to recoat POMs in the DOT coating plant. This was a challenging task as AGU is mounted inside the ARISS and the POMs being small in size, the optics and camera units are difficult to align once opened. A detailed procedure was evolved and executed to successfully refurbish the AGU by the engineering team. The guider camera after refurbishment was made available before the observing cycle.

6) Maintenance and upgradation works

Cabling issue for instruments

Both *TIRCAM2* on side-port1 and *AD-FOSC* on main-port use cooling pipes. Therefore, the problem of cable twisting was anticipated during movement of the telescope at certain positions. After several trials of different telescope positions, a certain configuration of *TIRCAM2* and *AD-FOSC* cables were found to be working successfully without any twisting.

Mechanical aspects and related works

Disassembly of azimuth cable wrap wheel, its refurbishment and assembly back with the telescope was completed. Old compressor was refurbished and provided as a spare in parallel with the existing compressor in the technical room of DOT. Development of brush arrangement for covering the dome gap between rotating and non-rotating part was in progress and brushes were procured for the same. Procurement of a few critical spares was accomplished. Load testing and certification of all the four overhead cranes in DOT was completed. Troubleshooting of the problems related to mechanical maintenance of DOT and its dome were accomplished for smooth operations.

Backend instruments on DOT

4k×4k CCD IMAGER

The 4k×4k CCD *IMAGER* was fully operational and utilised during the two observing cycles. Issue of stray light was resolved by designing a new baffle. Characterisation of the CCD camera, measurement of sky-brightness and extinction coefficients were done in the allotted IVT nights. The *IMAGER* data acquired so far has been used along with data obtained at other facilities, resulting in high impact scientific publications (total 12) on supernovae, GRBs and other celestial sources.

Figure 43 shows the field and light curve of a super luminous supernovae SN 2020ank observed with the *IMAGER*. The well-calibrated multi-band UBVRI data was useful to constrain the physical properties of the supernova suggesting a spin-down millisecond magnetar as a possible powering source for SN 2020ank.

It is planned to procure a new set of 10 broadband filters for the *IMAGER*.

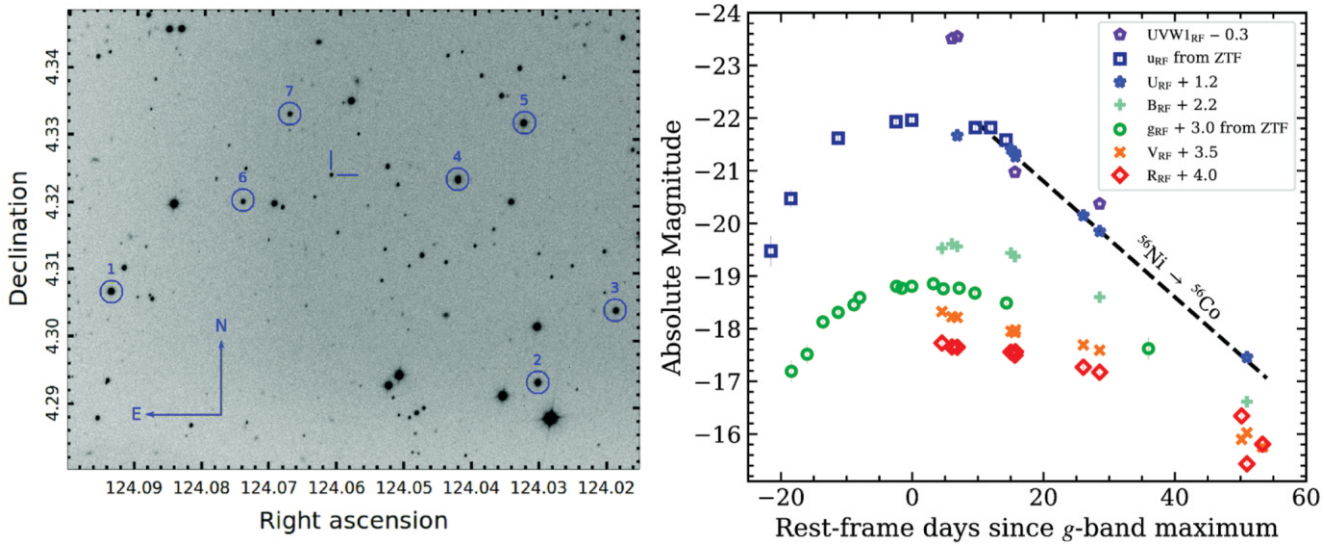


Figure 43. Left: SN 2020ank field observed with *IMAGER* on 19 March, 2020 in R band for an exposure time of 5 min. Right: multiband light curves of SN 2020ank.

ARIES Devasthal Faint Object Spectrograph & Camera (*AD-FOSC*)

The ARIES Devasthal Faint Object Spectrograph & Camera (*AD-FOSC*) instrument was used by astronomers from India and Belgium, on the 3.6m DOT during the observing cycles 2020C2 and 2021C1. *AD-FOSC* is a low-resolution (R < 2000) optical spectrograph capable of making deep (~25 mag AB), sub-arcsec resolution images of the celestial objects in imaging and spectroscopy modes. **Figure 44** shows the narrow band Hα image of the Crab Nebula taken with *AD-FOSC* imaging mode. The upgradation work on the instrument to enhance its observing capabilities in polarisation mode and medium dispersion mode was planned and started during this period. The polarisation mode uses single and dual Wollaston prisms.

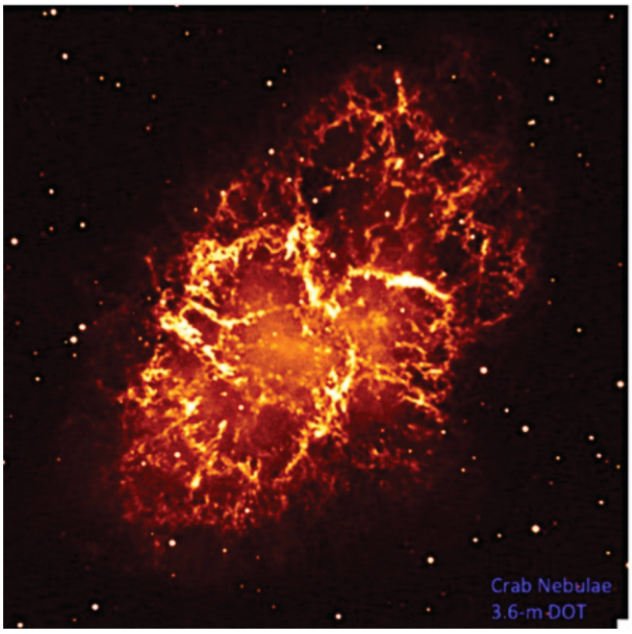


Figure 44. The narrow-band Hα image of the Crab Nebula taken from the 3.6m DOT using *AD-FOSC* imaging mode.

TIFR-ARIES Near Infrared Spectrometer (*TANSPEC*)

TANSPEC, built in joint collaboration with ARIES, TIFR and MKIR, Hawaii, is a unique spectrograph providing simultaneous wavelength coverage from optical to near-infrared (0.55-2.54 micron). This spectrograph operates in two modes – cross-dispersed (XD) high resolution mode and a low resolution prism mode. Several IVT observations along with science observations were successfully carried out during cycles 2020-C2 and 2021-C1. It was observed that *TANSPEC* routinely delivers sub-arcsec images in visible and near-infrared bands (**Figure 45**). With the new grating the XD mode was exhaustively tested. The sensitivity and science verification tests on XD mode were done (**Figure 46**). Faint spectroscopy of K ~13.6 mag star (S/N ~ 20) as well as a complete spectral coverage (from 0.55 to 2.5 micron) in XD mode was demonstrated. Spectra of different stars in XD mode is shown in **figure 47.**

Major maintenance activities included (i) replacement of grating, (ii) repair of grating wheel, (iii) installation of new ½ inch helium line, (iv) installation of a new chiller system, (v) installation of new apertures in the lamps and (vi) removal of software bugs etc.

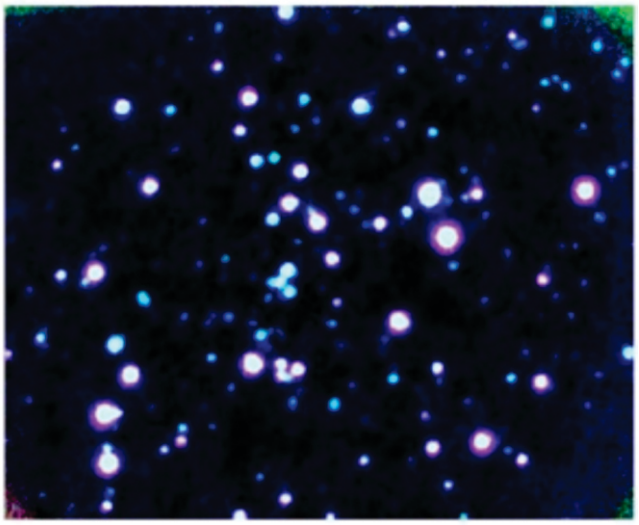


Figure 45. K band image with 1 hour exposure observed with *TANSPEC*. Image profile is ~0.8 arcsec.

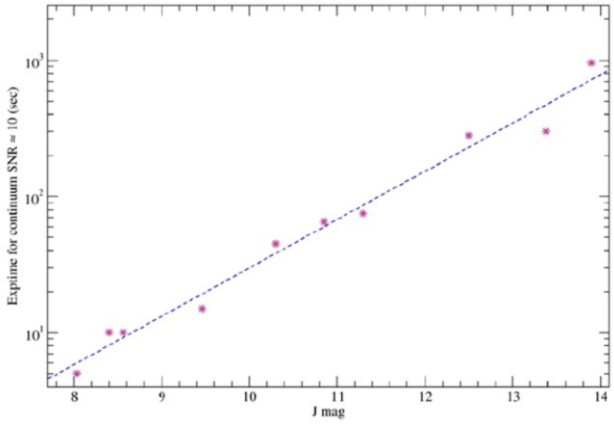


Figure 46. XD mode spectroscopic sensitivity.

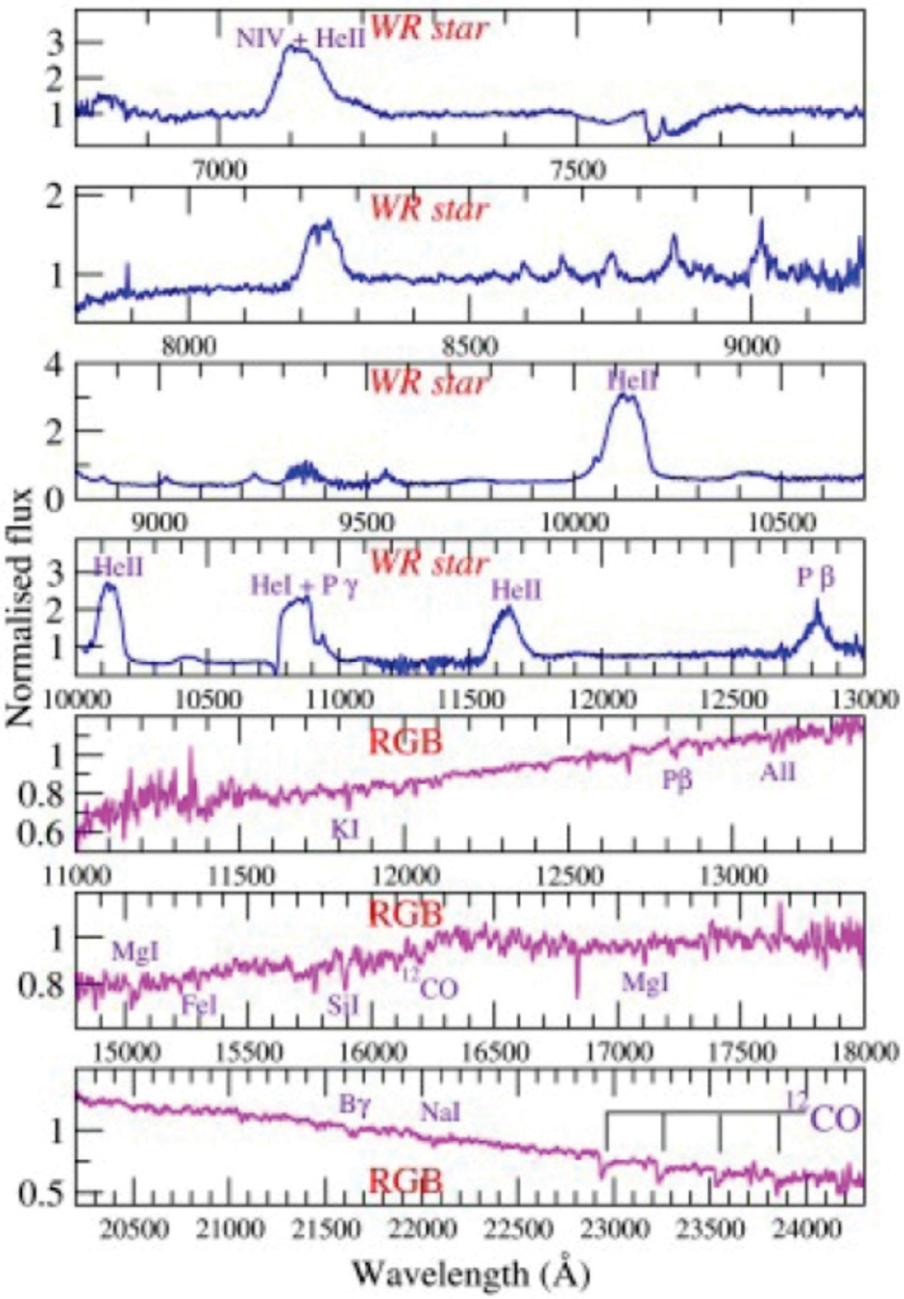


Figure 47 : Spectra of different stars in XD mode.

TIFR Near Infrared Imaging Camera-II (*TIRCAM2*)

TIRCAM2 is a closed-cycle Helium cryo-cooled camera capable of providing near-infrared imaging observations in the wavelength range from 1 to 3.7 microns. It was permanently mounted on side port1 of DOT and was always available for simultaneous observations along with the main port instruments. Regular science observations were done as and when required. 3 research articles were published using *TIRCAM2* data in this period.

Major maintenance activities were (i) a new patch of software developed by TIFR to read frames at a fast readout speed of 10 ms was installed on *TIRCAM2* PC,. (ii) the Helium lines were re-routed through the telescope structure on the telescope floor when *TANSPEC* was mounted on the main-port of the telescope, (iii) leakage in the Helium pipe was rectified.

1.3m Devasthal Fast Optical Telescope (DFOT)

The 1.3m DFOT situated in Devasthal is used as one of the main observing facilities by researchers at ARIES since 2010. Regular preventive maintenance for the upkeep of the telescope is carried out by the scientific and engineering staff of ARIES. Two CCD cameras, 2k×2k Andor Dz436 and 512×512 Andor iXon EM+DU-897, are currently available as backend instruments with the telescope for imaging celestial sources.

Although a wide range of observing programmes run on the 1.3m telescope, the three main science programmes were (i) star clusters, star forming regions and stellar variability, (ii) monitoring of GRB afterglows and supernovae and (iii) variability studies of AGNs. On an average over subscription factor of two has been observed on 1.3m DFOT with respect to the requested and available nights. During 2020-21 total 243 nights were allotted for observing out of which 45 nights were lost due to bad weather. Useful scientific data was collected during 198 nights. More than 20 research articles were published in refereed journals during 2020-21 apart from numerous circulars and conference proceedings.

1.04m Sampurnanand Telescope (ST)

The 1.04m Sampurnanand Telescope (ST) situated at Manora Peak is used as one of the main observing facilities by researchers at ARIES since 1972. Regular preventive maintenance for the upkeep of the telescope is carried out by the scientific and engineering staff of ARIES. The major backend instruments mounted on 1.04m ST are 4k×4k CCD Imager and ARIES Imaging Polarimeter (AIMPOL). A PyLon 1300×1340 CCD is also sometimes used for imaging and polarimetric observations.

The major scientific programmes with this telescope include studies of star clusters, young star forming regions, HII region, optical variability in AGN, optical counterpart of GRBs, supernovae and X-ray sources and polarimetric study of star forming regions and late type stars. About 77% observing nights were allotted for imaging while 23% nights were allotted for polarimetric observations. About 50% of the clear nights were used for scientific observations. Instrument calibration and telescope testing were performed during engineering nights and bright period. Six articles were published during 2020-21.

ARIES Stratosphere Troposphere Radar (ASTRAD)

ARIES successfully operate the 206.5 MHz ST Radar (ASTRAD) which is designed and developed in India. Extensive campaign based observations and diurnal observations were made with ASTRAD followed by rigorous exercises of validation, including several phases of different combination of the total 12 clusters (588 units). Observations during 2020-21 are shown in **Figure 48.** Preventive maintenance was executed routinely along with various in-house developments and upgradation of the subsystems. ARIES joined hands in a collaborative research program of five ST-MST radars in the country to impart training on radar basics and systematically perform simultaneous observations.

VHF radars have unique capability of simultaneous identification of echo from clear air and precipitation. ASTRAD was used for the classification of different precipitation systems over the Himalayas. An event of intense convection associated with a severe weather system like thunderstorm was captured by ASTRAD (**Figure 49**). The intense phase of updraft and downdraft was also seen.

ASTRAD has displayed a capability of observing up to about 31 km with a clear demarcation of the tropopause (**Figure 50**). A reversal in wind direction was clearly seen in the lower stratosphere, being mostly easterly as compared to westerly in the tropopause.

A graphical user interface based software (**Figure 51**) for offline data analysis was developed by ARIES. This is an important component for data analysis while observing from regions having complex topography (**Figure 52**). The main features of the software are (i) removal of ground and terrain clutter echoes without affecting clear air echoes (ii) automatic identification and elimination of radio frequency interference bands from the data (iii) adaptive selection of the clear air echoes by employing optimum Doppler window for signal search (iv) separating clear air and precipitation echoes and separate moments estimation (v) batch processing of radar data.

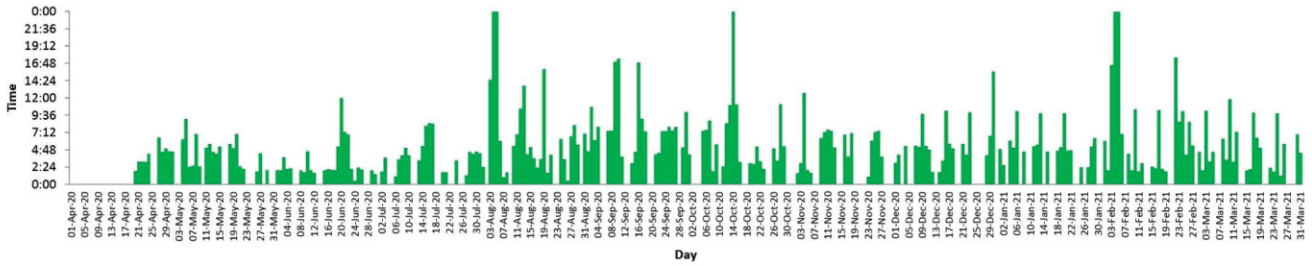


Figure 48. Temporal details of observations from ASTRAD during 2020-21.

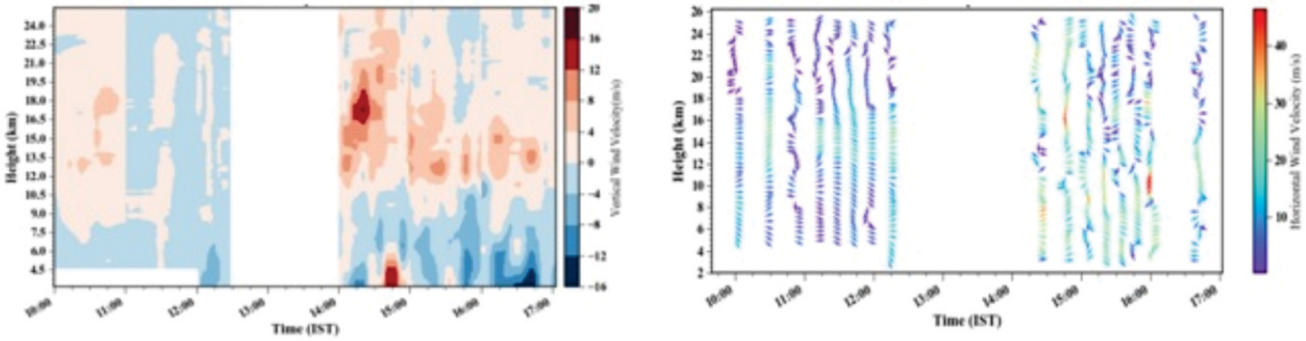


Figure 49. Observations from ASTRAD during May 2020 showing intense phase of updrafts and downdrafts. Sudden change in winds during convection was also seen.

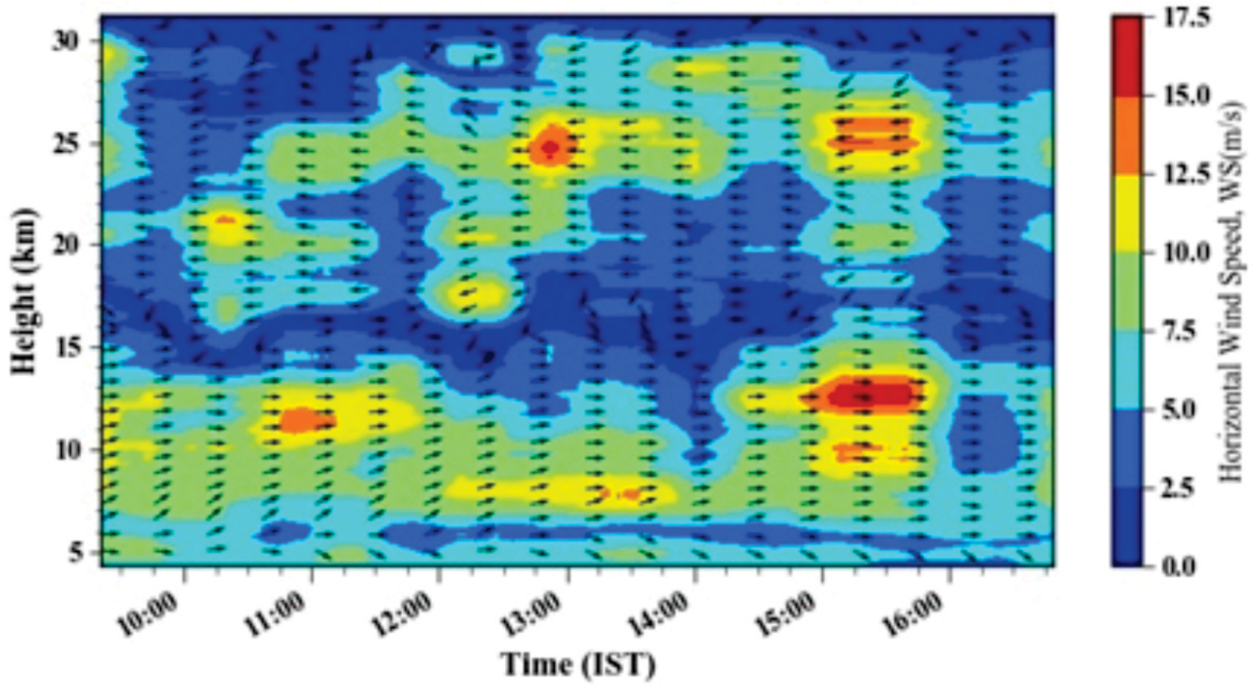


Figure 50. ASTRAD observation up to about 31 km with a clear demarcation of the tropopause.

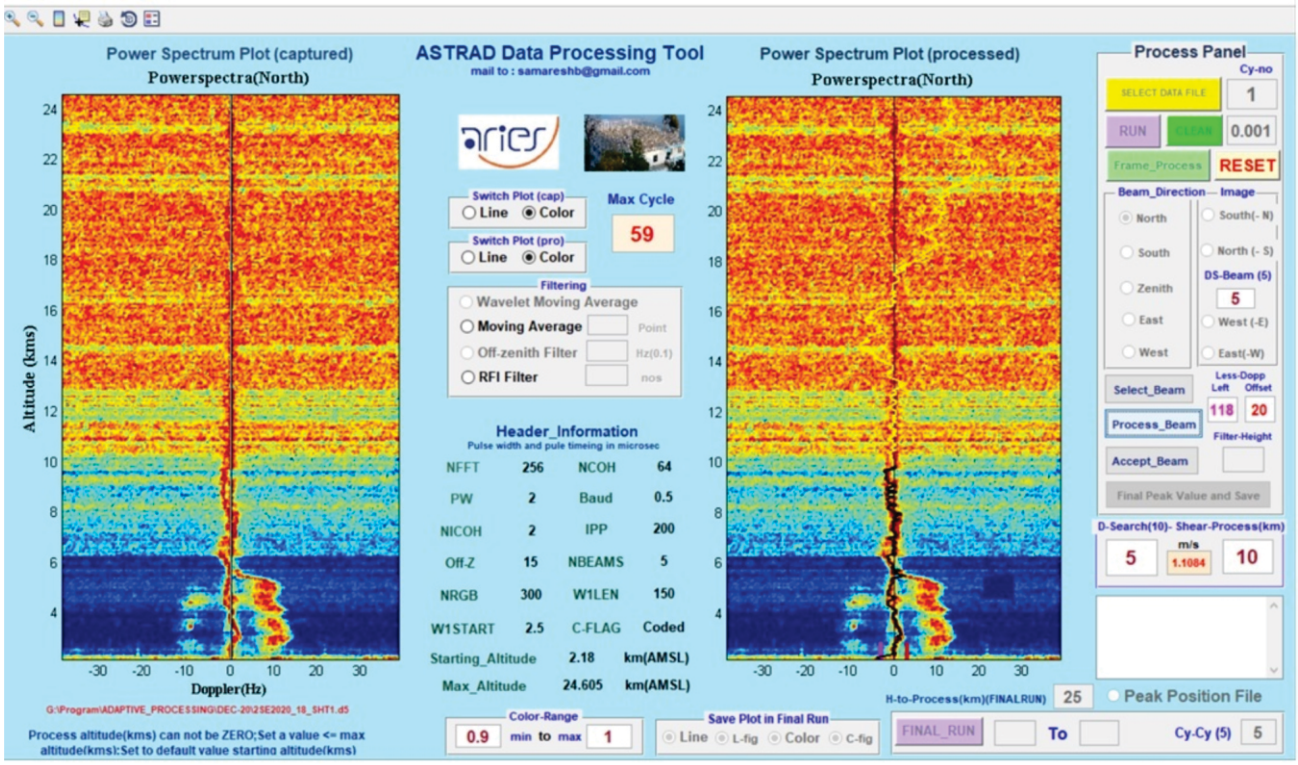


Figure 51. The graphical user interface of the software developed for ASTRAD.

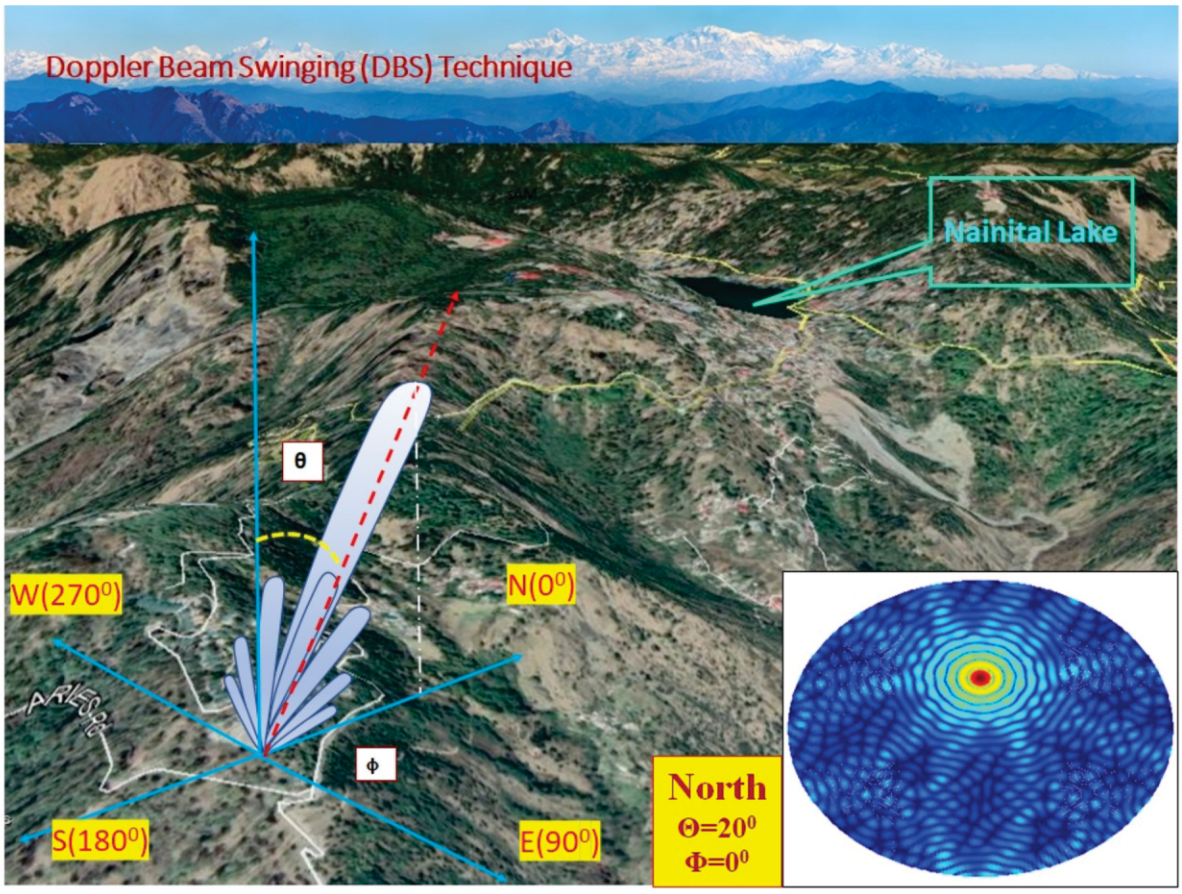


Figure 52. Location of ASTRAD (along with concept of side lobes) with display of the regional topography.

Upcoming Facilities

4m International Liquid Mirror Telescope (ILMT)

The 4.0m International Liquid Mirror Telescope (ILMT) is established at Devasthal observatory (ARIES, Nainital) in collaboration with the Institute of Astrophysics and Geophysics (Liege University, Belgium) and Canadian Astronomical Institutes from Quebec (Laval University), Montreal (University of Montreal), Toronto (University of Toronto and York University), Vancouver (University of British Columbia) and Victoria (University of Victoria).

The ILMT will perform observations by looking toward the zenith direction (best atmospheric seeing condition). The images passing over its field-of-view will be captured with the help of a highly efficient 4k×4k CCD camera. The ILMT is a dedicated facility for photometric and astrometric variability survey of a narrow strip of sky (about half a degree). The CCD images recorded each night will be matched to a reference image to detect transient and variable stellar sources. The first light of ILMT was planned during December 2020 but was delayed due to the unforeseen situation of COVID-19. Upon favourable situations, the first light is expected in early 2022.

Meanwhile, various important preventive activities have been completed to avoid any possible issue during the first light. These include periodic operation of the hatch cover to verify the proper functioning of the components. The support strips and insulators require proper maintenance. A few of the damaged support strips and insulators were replaced for a proper functioning. The arrangement to pour mercury during regular operation of the telescope is an integral part. A new set of hand-wheel and metallic linear stage in the mercury pumping system was assembled which will be tested and operated during the first light. The ILMT container/bowl is cleaned from time-to-time when the surface becomes dirty using a vacuum cleaner and wiped with isopropanol. Foreseeing the first light, the first ILMT workshop was held on 29, 30 June and 01 July 2020 to discuss the observational strategy, science outcomes and data pipeline aspects which was attended by 100 participants from both India and abroad.

Installation of 14 inch telescope

The ILMT observations will be performed using Time Delay Integration (TDI) technique (electronically stepping the relevant CCD charges). To understand the technical aspects and generating/testing the ILMT data reduction pipeline, a 14 inch Celestron telescope was installed at the 1.3m DFOT floor in Devasthal (**Figure 53**). TDI images are obtained using a 2048×2048 pixels CCD camera (SBIG STL-4020M) mounted with the 14 inch telescope in r' filter. Testing of ILMT data reduction pipeline is under progress using these TDI images.

Figure 53. Fully installed 14 inch telescope along with the CCD.

Mercury safety

The ILMT primary mirror will be formed with mercury whose vapours are toxic in nature. Proper handling of safety instruments is necessary. Before the first light and regular operations, training to safely handle the mercury should be imparted to the people involved in the project. In this context, a training/demonstration session was organized on 6 October, 2020 (**Figure 54**).

Figure 54. Left panel: Sprinkling sulphur impregnated charcoal around the contaminated area. Right panel: Using a mercury vacuum cleaner to clean the contaminated area.

Aditya-L1 Support Cell (AL1SC)

Aditya-L1 mission is the India's first dedicated solar space mission. It needs a community service centre for the guest observers in preparing science observing proposals and analysing science data. In this regard, *Aditya-L1* Support Cell (AL1SC), a joint effort of ISRO and ARIES, is being set up at the transit campus of ARIES at Haldwani, Uttarakhand. This center will jointly work with ISRO to maximize utilization of science data from *Aditya-L1*. ARIES signed an agreement with ISRO for this AL1SC, which will act as conduit between the users (students and faculty members from research institutes/universities/colleges etc.) and payload teams of *Aditya-L1* and solar astronomy research community at large. It will develop specific tools to assist guest observers/researchers to prepare observing proposals for *Aditya-L1* observations. It will assist ISRO with the design and development of the required analysis software for handling scientific data.

AL1SC will bring sample data from different instruments onboard *Aditya-L1* to a single web-based interface. This will enable researchers/users to quickly look at the data and identify the interesting science cases. AL1SC will also provide the co-aligned data from other observatories around the world that can complement the data obtained from *Aditya-L1*. This will allow users to accomplish the science goals beyond the capabilities of the *Aditya-L1*.

In addition to this, AL1SC will also establish periodic training of the national user community on data analysis and proposal preparation. Short workshops of 2-3 days duration will be held at different locations in India focusing on universities, who do not have access in downloading and analyzing the *Aditya-L1* data. Further, AL1SC has also planned to schedule frequent e-workshops, tutorials using online platforms. This centre will expand the visibility of *Aditya-L1* beyond India at the international level, in addition to expanding its reach within India.

Figure 55. Signing of MoU between ARIES and ISRO.

Thirty Meter Telescope (TMT)

During the year, ARIES continued participation toward many activities related to the TMT project and toward regular activities of India-TMT. Scientists and Engineers from ARIES participated in Scientific Advisory Committee meetings, regular meetings of the Project Management Board (PMB) and Management Advisory Committee (MAC) meetings during the year. Science team members, from ARIES, of Infrared Imaging Spectrograph (IRIS) backend instrument on TMT were involved in simulations of very high redshift sources such as supernovae. The applicability of adaptive optics in TMT with IRIS instrument and possible science cases were discussed in which ARIES scientists also participated. This received special attention primarily due to the observational findings about existence of supermassive black hole at the center of the galaxy using Keck telescopes+NIR capabilities. This work by Prof. Andrea Ghez won the Nobel Prize in Physics 2020. ARIES engineers are also involved in the design and development of electronics related to Wide-Field Optical Spectrometer (WFOS) backend instrument.

During the year, Director ARIES, Prof. Dipankar Banerjee was nominated as the chairperson of the PMB constituted to look into India-TMT related activities.

Academic Programme of ARIES

Academic Committee (AC) aims at enhancing the academic environment of the Institute by looking after academic affairs of the research students in ARIES. The present members of the committee are:

Dr. Indranil Chattopadhyay (Chair);

Dr. Alok C. Gupta (Co Chair);

Dr. U. C. Dumka;

Dr. Yogesh Joshi;

Dr. Saurabh;

Dr. Kuntal Misra;

Dr. T. S. Kumar;

Mr. Ramdayal Bhatt (secretary to the AC).

The major activities of academic committee are:

[A] Preparation of the syllabus and managing the pre-Ph. D. course work of ARIES

The pre-Ph. D. course work in ARIES is aimed at preparing the fresh Ph. D. students into the world of cutting edge research in astronomy & astrophysics and atmospheric sciences. There were ten topics taught during the course work. The extensive course work is followed by rigorous examination. Each instructor takes the examination under the supervision of the AC, and evaluates the students as per the criteria made by the AC.

[B] Reviews of PhD students

AC arranges the reviews of the first year students after the completion of the course work. In 2020, AC conducted the examination and project presentations of the first year batch and following students successfully negotiated the pre-Ph. D. course work, and entered the main PhD programme of ARIES:

(1) Mr. Gurpreet Singh; (2) Ms. Bhavya; (3) Mr. Nitin Vashistha; (4) Mr. Rahul; (5) Mr. Shubham Kishore; (6) Mr. Arvind Kumar

AC also arranged the reviews of the senior students, including the second year students who got promoted from JRF to SRF. The following are the students who successfully negotiated JRF-SRF review:

(1) Akansha Rajput; (2) Dimple; (3) Mahendar Chand Rajwar; (4) Nikita Rawat; and (5) Raj Kishor Joshi

[C] Joint Entrance Screening Examination (JEST)

Academic Committee actively participated in the overall planning of the JEST on the behalf of ARIES. One of the members of AC (Dr. U. C. Dumka) took the responsibility of conducting the JEST 2020 examination at Nainital centre and the exam was conducted after March, 2021.

[D] Ph. D. entrance interviews

AC organizes interviews every year to select PhD students as Junior Research Fellows (JRFs) in ARIES. Dr Saurabh and other AC members screened all applications and interviews were conducted during 27-30 July, 2020. Students who held M. Sc. in physics/ astrophysics and had qualified JEST/NET/GATE were invited to appear for the interviews. Inspire qualified students were also considered for the interviews provided they fulfilled other general criteria. Candidates who successfully qualified the interviews were selected as JRFs and were inducted in ARIES to undergo a pre-PhD course work. Eleven students joined ARIES.

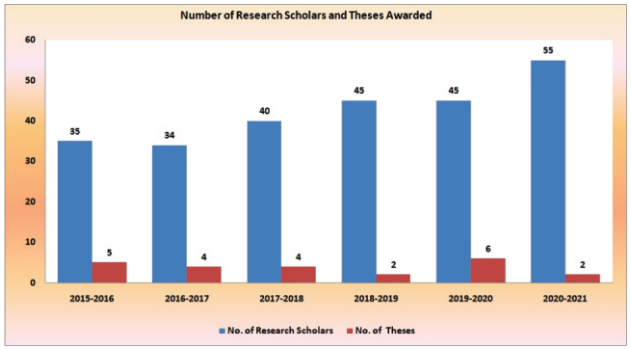
(1) Ms. Aayushi Verma; (2) Mr. Amit Kumar; (3) Mr. Atul Pathania; (4) Mr. Devanand P. U.; (5) Ms. Dibya Kirti Mishra; (6) Ms. Jyoti Sheoran; (7) Mr. Mrinmoy Sarkar ; (8) Mr. Naveen Dukiya; (9) Mr. Sanjit Debnath; (10) Ms. Shivangi Pandey; (11) Ms. Upasana Baweja

[E] Summer Project Students

The summer internship is one of the significant programmes of the academic committee. In this, we intend to provide training to Bachelors/Masters level students from various universities/institutes and provide them glimpses of the cutting-edge research and development activities that are being carried out in the Institute. Due to COVID-19 related restrictions, these projects were conducted online.

[F] PhD Thesis

Two students of ARIES were awarded Ph. D. degree and three have submitted their theses during 2020-2021.



Awarded

Parveen Kumar was awarded Ph. D. degree on 7 January, 2021. His thesis titled "Probing the nature of radio-quiet weak emission line quasars" was submitted to the Pt. Ravishankar Shukla University, Raipur. He carried out this work under the supervision of **Hum Chand**.

Anjasha Gangopadhyay was awarded Ph. D. degree on 6 February, 2021. Her thesis titled "Observational study of core collapse supernovae with diminishing Hydrogen envelop" was submitted to the Pt. Ravishankar Shukla University, Raipur. She carried out this work under the supervision of **Kuntal Misra**.

Submitted

Kuldeep Singh submitted his thesis titled "The study of astrophysical magnetized flows" to University of Delhi in March, 2020. The research was done under the supervision of P. D. Gupta and **Indranil Chatto-padhyay.**

Sapna Mishra submitted her thesis titled "Probing environment of AGNs based on their feedback processes" to University of Delhi in September, 2020. The research was done under the supervision of T. R. Seshadri and **Hum Chand**.

Raya Dastidar submitted her thesis titled "Study of core-collapse supernovae and their progenitors" to University of Delhi in September, 2020. The research was done under the supervision of T. R. Seshadri and **Brijesh Kumar**.

[G] Post Doctoral Fellows/Research Associates

Twelve PDFs/RAs are at ARIES during 2020-2021.

[H] Orientation Programme 2020

Every year Academic Committee organises orientation programme to welcome new students, and distributes pre-Ph. D. course certificates to successful and outgoing first students of ARIES. Orientation programme in 2020 was held in online mode.

[I] The guidelines for the Ph. D. program

The guidelines for Ph. D. programme were standardised, got approved from competent authority and were put up on the institute website.

[J] Talk/Poster presentations delivered by research scholars

Aditya Jaiswal

Assessment of wind pattern and turbulence associated with boundary layer during monsoon season over central Himalayan site using ARIES ST Radar, 14-17 December, 2020, Tropmet 2020, Weather and Climate services over mountainous regions. *(talk)*

Alaxender Panchal

Photometric and spectroscopic analysis of four contact binaries, 27-28 March, 2020, Students Research Convention 21 (SRC), IIT, Kanpur. *(talk)*

Amit Kumar

SN 2020ank: a bright and fast-evolving H-deficient superluminous supernova, 18-23 February, 2021, The 39th Meeting of the Astronomical Society of India. *(poster)*

Anjasha Gangopadhyay

Probing the progenitor scenario of stripped envelope supernovae using HCT, 29-30 September, 2020, HCT@20, IIA, Bengaluru. *(poster)*

SN 2019wep: bridging the gap between type Ibn and Ib supernova, 18-23 February, 2021, The 39th Meeting of the Astronomical Society of India. *(poster)*

Avrajit Bandyopadhyay

Origin and abundances of r-process rich stars in the Galaxy, 29-30 September, 2020, HCT@20, IIA, Bengaluru. *(talk)*

Probing the nature and sites of r-process using high resolution spectroscopy, 1-3 February, 2021, iPrecision Spectroscopy Stellar connections: from Galaxy evolution to exoplanets, SAMPA-IAG/USP, Sao Paulo, Brazil. *(poster)*

Study of Milky Way Halo stars and connection to globular clusters, 18-23 February, 2021, The 39th Meeting of the Astronomical Society of India. *(thesis talk)*

2-6 November, 2020, Gaia Symposium: DR2 and Beyond . *(participant)*

Bibhuti Kumar Jha

Signature of quenching from observation of tilted bipolar magnetic regions on the Sun, 1-4 March, 2021, Advances in Observation and Modelling of Solar Magnetism and Variability, IIA, Bangaluru. *(talk)*

Jayanand Maurya

Photometric and kinematic study of the open clusters SAI 35, SAI 44, and SAI 45, 31 August - 1 September, 2020, International Conference on Dust in Astrophysics, Assam University, Silchar. *(talk)*

Kiran Wani

18-23 February, 2021, The 39th Meeting of the Astronomical Society of India. *(participant)*

Mahendar Chand Rajwar

Diurnal and seasonal variations in some non-Methane Hydrocarbons (NMHCs) over Nainital: The central Himalayan site, 14-16 September, 2020, International Conference on Aerosol Air Quality, Climate Change and Impact on Water Resources and Livelihoods in the Greater Himalayas, ARIES, Nainital. *(talk)*

Light NMHCs over the central Himalayas region: variabilities and ozone production potential in ambient air over a site in central Himalayas, 1-17 December, 2020, AGU Fall Meeting 2020. *(poster)*

Pankaj Kushwaha

Radiative processes in Astrophysics, 16 June, 2020, ARIES, Nainital. *(e-lecutre Series)*

Candidate binary SMBH blazar OJ 287 in very different X-ray spectral states with AstroSat, 19-21 January, 2021, International Conference on 5-years of *AstroSat*, ISRO, India. *(talk)*

Deciphering the nature of the re-emerged broadband emission seen during the 2020 multi-wavelength activity of blazar OJ 287, 18-23 February, 2021, The 39th Meeting of the Astronomical Society of India. *(talk)*

Understanding the new spectral state of the candidate binary black hole blazar OJ 287, 22-28 February, 2021, 1st Electronic Conference on the Universe, ECU2021. *(talk)*

Prajjwal Rawat

Role of long-range transport, downward transport and biomass burning on the tropospheric ozone over the central Himalaya, 1-17 December, 2020, AGU Fall Meeting 2020. *(poster)*

Radiance inter-calibration of INSAT-3D ozone channel with MSG-SEVIRI and successive improvements in ozone retrieval and validations, 14-17 December, 2020, TROPMET-2020, ISRO-NESAC. *(talk)*

Variabilities in ozone over the Himalayan atmosphere: role of precursors, meteorology, and dynamics, 14-16, September, 2020, International Conference on Aerosol Air Quality, Climate Change and Impact on Water Resources and Livelihoods in the Greater Himalayas, ARIES, Nainital. *(talk)*

Priyanka Jalan

25 July - 1 October, 2020, Introduction to Optical and Infrared Interferometry, IUCAA, Pune. *(participant)*

Priyanka Srivastava

Tiny carbon bombs in the atmosphere: An insight into the world of carbonaceous aerosols, 24 August, 2020, University of Delhi, Delhi. *(talk)*

Insights from intensive long-term observations of

carbon aerosols and trace gases at the Central Himalayas, 14-16 September, 2020, International Conference on Aerosol Air Quality, Climate Change and Impact on Water Resources and Livelihoods in the Greater Himalaya, ARIES, Nainital. *(talk)*

Insights from intensive long-term observations of carbon aerosols and trace gases at the central Himalayas, 17 December, 2020, TROPMET-2020, National Symposium on Weather and Climate Services over Mountainous Regions, Umiam, Shillong, Meghalaya. *(talk)*

Rahul Gupta

Prompt emission of gamma-ray bursts, 30-31 May, 2020, National E-Conference on Interdisciplinary Research in Science and Technology (NCIRST-20). *(poster)*

Observational properties of VHE detected GRB 180720B, GRB190114C, and GRB 190829A, 18-23 February, 2021, The 39th Meeting of the Astronomical Society of India. *(poster)*

29 June – 01 July 2020, The first ILMT workshop, ARIES, Nainital. *(participant)*

17-21 August, 2020, GROWTH Astronomy School 2020. *(participant)*

18-22 January, 2021, Astronomy Winter School: High-Energy Astrophysics, National Center for Theoretical Sciences, Physics Division, Taiwan. *(participant)*

Rakesh Mazumder

Simultaneous longitudinal and transverse oscillations in filament threads after a failed eruption, 8-11 December, 2020, Online meeting on MHD Coronal Seismology 2020: Twenty Years of Probing the Sun's Corona with MHD Waves of Warwick, UK. *(talk)*

Study of long term properties of filaments from synoptic maps, 01-04 March, 2021, IIA-50, Advances in Observation and Modelling of Solar Magnetism and Variability, IIA, Bangaluru. *(poster)*

Raya Dastidar

SN 2016B: an intermediate type II supernova, 29-30 September, 2020, HCT@20, IIA, Bengaluru. *(poster)*

Intermediate type II supernovae: A case study of SN 2016B, 18-23 February, 2020, The 39th Meeting of the Astronomical Society of India. *(poster)*

Ritesh Patel

A statistical study of plasmoids associated with a post-CME current sheet, 18-23 February, 2021, The 39th Meeting of the Astronomical Society of India. *(poster)*

A statistical study of plasmoids associated with a post-CME current sheet, 1-4 March, 2020, Advances in Observation and Modelling of Solar Magnetism and Variability, IIA, Bangaluru. *(poster)*

Sadhana Singh

Polarimetric study toward open star cluster NGC 1817, 31 August – 1 September, 2020, International Conference on Dust in Astrophysics (ICDA-2020), Assam University, Silchar. *(talk)*

Optical linear polarization toward the open star cluster Casado Alessi 1, 2-6 November, 2020, Gaia Symposium: DR2 and Beyond, IIA, Bengaluru. *(talk)*

A multi-band linear polarimetric study toward cluster NGC 2345, 18-23 February, 2021, The 39th Meeting of the Astronomical Society of India. *(talk)*

Shilpa Sarkar

Research methodology and practices, 7 July, 2020, Presidency University, Kolkata, India. *(invited)*.

Two-temperature advective transonic accretion flows around black holes, 10 July, 2020, Presidency University, Kolkata, India. *(talk)*

Two-temperature advective transonic accretion flows around black holes, 15 July, 2020, Presidency University, Kolkata, India. *(colloquium)*

Two-temperature advective transonic accretion flows around black holes, 14-15 September, 2020 International e-Conference on Plasma Theory and Simulations, Guru Ghasidas Central University, Bilaspur, India. *(poster)*

Pair production and annihilation in advective accretion disks around black holes, 14-18 October, 2020, Third Virtual Workshop on Numerical Modeling in MHD and

Plasma Physics: Methods, Tools, and Outcomes, Moscow, Russia. *(talk)*

Sindhu Pandey

M67: Discovering unknown systems with UVIT detection, 1-3 December, 2020, UVIT: 5 years of operation, IIA, Bengaluru. *(talk)*

Multiwavelength study of old open clusters: NGC 188 and M67, 18-23 February, 2021, The 39th Meeting of the Astronomical Society of India. *(thesis presentation)*

2-6 November, 2020, Gaia Symposium: DR2 and Beyond . *(participant)*

1-3 February, 2021, Precision Spectroscopy Stellar Connections: from Galaxy Evolution to Exoplanets, SAMPA-IAG/USP, Sao Paulo, Brazil. *(participant)*

Tirthendu Sinha

Pre-main sequence variables in young open clusters, 18-23 February, 2021, The 39th Meeting of the Astronomical Society of India.*(talk)*

Vineet Ojha

Comparative intranight optical variability study of radio-loud narrow-line Seyfert 1 galaxies with and without radio jets, 18-23 February, 2021, The 39th Meeting of the Astronomical Society of India. *(talk)*

Vivek Kumar Jha

Properties of broad and narrow line Seyfert galaxies selected from SDSS, 17-20 September, 2020, Astronomical Surveys and Big Data 2 (ASBD-2), Byurakan Astrophysical Observatory (BAO), Armenia. *(talk)*

Knowledge Resource Center

The mark of a progressive institution is judged by the strength of its library, which has been aptly termed "Library is a growing organism" fifth law of library science given by Prof. S. R. Ranganathan, an authority on library science. Ever since the inception of the Observatory in 1954, the library has been steadily building up through the years and is now known to be one of the best libraries amongst those belonging to any similar scientific research institutions in the country. Institute has a well stocked automated library which is named as Knowledge Resource Centre (KRC) (**Figure 56**). It is facilitated with Wi-Fi connectivity. The ARIES KRC acquires books and journals mainly related to Astronomy & Astrophysics and Atmospheric Sciences. The KRC also acquires reference books time to time. The KRC is a member of Forum for Resource Sharing in Astronomy and Astrophysics (FORSA), which was established by Indian Astronomy Librarians in 1979. The KRC is also a member of National Knowledge Resource Consortium (NKRC). NKRC provides free access of subscribed online databases to DST and CSIR institutions.

KRC Resource Development

During the period 2020–2021, the following information resources were added:

Subscription to Journals	:74 (Print + Online) + Full Text Databases
Publications in refereed journals	: 93
Theses awarded	: 02

The collection at the end of the period is

Books	: 11,023
Bound volumes of Journals	: 11,205

Apart from books and journals, other materials such as slides, charts, maps, diskettes, CD-ROMs, etc. are also available in the KRC. Libsys 4.0 was upgraded to Libsys 10.0 which has more user friendly features. The user friendly features of Online Catalogue are also available at Web-OPAC in 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.

Figure 56. KRC main reading hall.

ARIES Science Popularisation & Public Outreach Programme (ASPOP)

ARIES has a very active science popularisation and outreach program, ASPOP, for disseminating scientific knowledge to students and common citizens, particularly in remote hilly regions, as part of scientific social responsibility. Being located close to the famous hill station of Nainital, ARIES used to get a lot of visitors every year, especially during the peak tourism periods. This year was unlike any other due to the COVID-19 pandemic and the associated restrictions. As a result, visits to the science centre and in-person outreach activities were suspended for most of the year. However, ARIES ably overcame this challenge by conducting outreach activities through online platforms, its new website, and social media to open a new way for reaching the public at large. ARIES members were also invited by other organisations to deliver several popular talks via online media. The following are some of the major science outreach activities:

National Science Day on 28 February, 2021

This year National Science Day was celebrated virtually at ARIES by connecting to around 100 local school/college students. Multiple activities were conducted through out the day including popular science talks, quiz and extempore speech competitions. The students also interacted with a team of young PhD students and scientists of ARIES (**Figure 57**).

Figure 57. Glimpse of National Science Day celebration.

Annular Solar Eclipse on 21 June, 2020

An annular solar eclipse occurred on 21 June, 2020 with the path of annularity passing through northern India. It was observed as a partial eclipse at ARIES (**Figure 58**). Solar eclipses are one of the most enthralling astronomical events. Hence, webcasting of the complete event was planned and live streamed on ARIES's social media pages for wider reach. The webcast resulted in more than a lakh online views. A couple of days earlier a special webinar 'The Science of Solar Eclipses' by Prof. Dipankar Banerjee, Director, ARIES was live streamed on social media to generate interest and create awareness among students and the public (**Figure 59**). The webinar has been viewed over 4000 times. Local print/electronic media persons were also briefed on the eclipse day following COVID-19 norms.

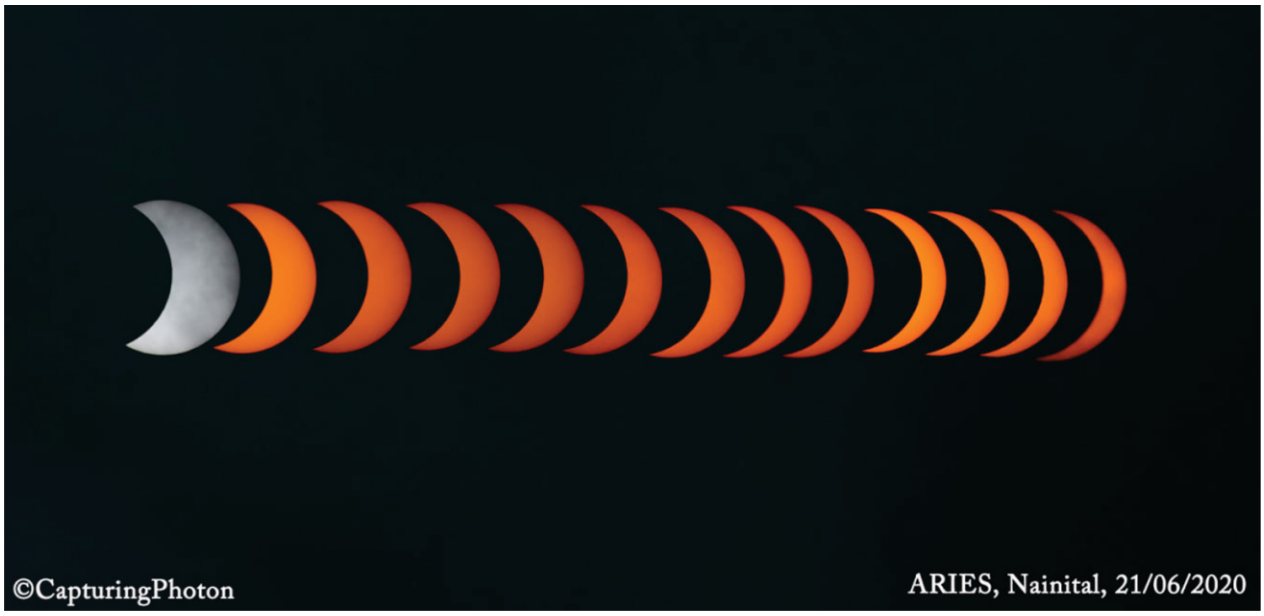


Figure 58. Montage of Solar Eclipse.

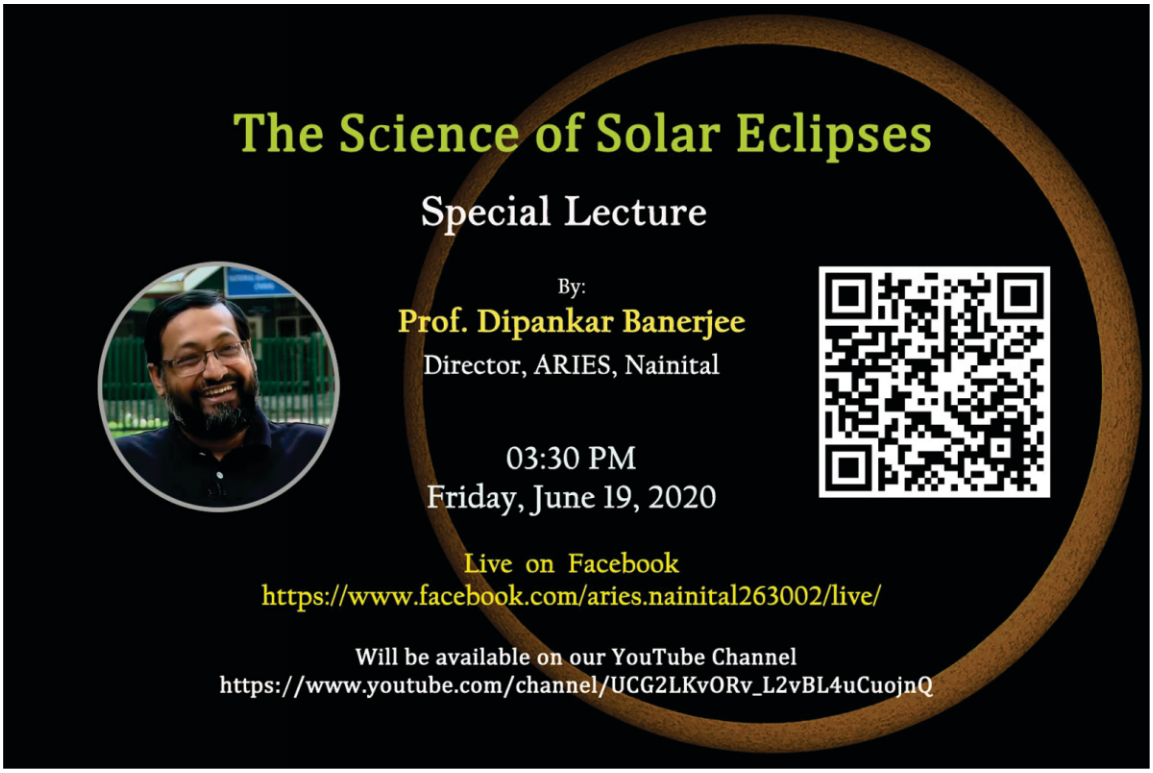


Figure 59. Science of Solar Eclipses webinar.

Great conjunction of Jupiter and Saturn on 21 December, 2020

This year's conjunction between the two great planets was the closest visible conjunction of the last nearly 800 years. As a result, there was a lot of curiosity and excitement among the masses. The positions of the two planets were monitored for around a month from the beginning of December, 2020. Jupiter and Saturn had their closest approach on 21 December, which was observed through the various telescopes of ARIES as well as captured by a group of young PhD students. The event was widely reported through various print/ electronic media and social media handles of ARIES (**Figures 60 and 61**).

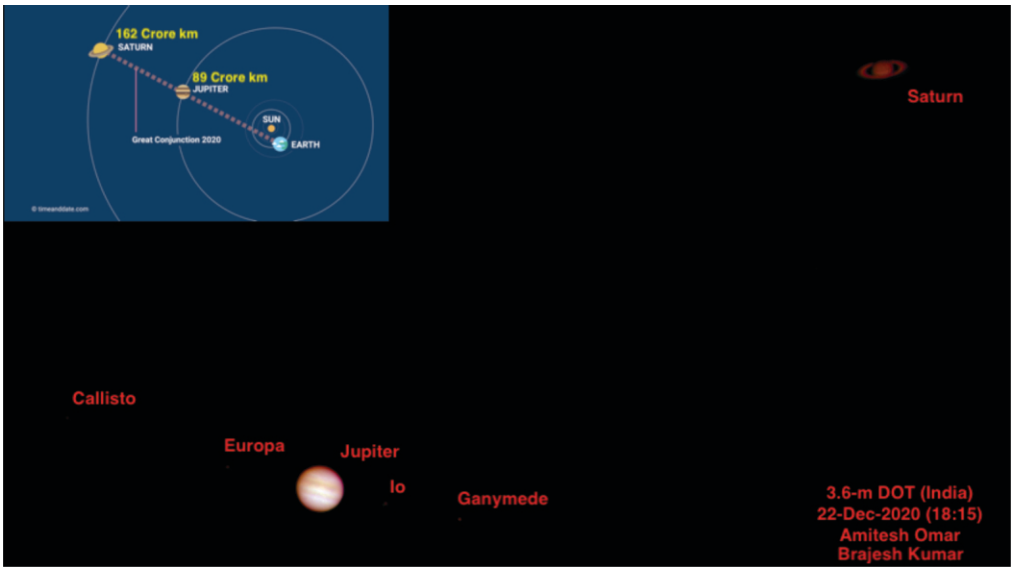


Figure 60. Great Conjunction of Jupiter and Saturn through 3.6m DOT.

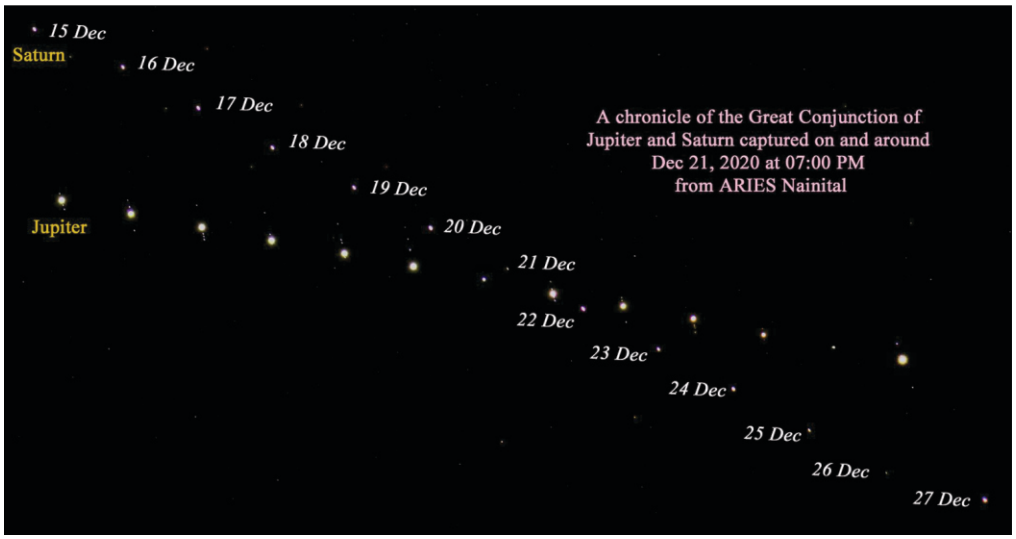


Figure 61. A chronicle of the Great Conjunction. *(image credit: Bibhuti Kumar Jha and Ritesh Patel)*

Initiatives in Association with Other Organisations

ARIES scientists regularly gave inputs based on their recent research to the DST media cell. As a result, more than a dozen popular science stories were featured on *Vigyan Samachar*, a new initiative by DST. ARIES was rated in the top three institutions by the DST media cell under this initiative. As part of the Golden Jubilee celebrations of DST, ARIES collaborated with Vigyan Prasar to shoot a documentary about ARIES, its legacy, achievements and future road map during August-October, 2020. ARIES also collaborated with IMAK (an agency nominated by DST/Vigyan Prasar) in the production of an episode (Disaster Management) of *Science for a Self-Reliant India* programme series as part of *Atmanirbhar Bharat* vision of the honourable Prime Minister of India, Shri Narendra Modi. ARIES also participated in the virtual curtain raiser ceremony of the India International Science Festival (IISF) 2020.

In addition to the above activities, ARIES scientists communicated with local print/electronic media on several occasions throughout the year to popularise many astronomical events such as eclipses, occultations, conjunctions, comets/asteroids approaches, the science stories featured on *Vigyan Samachar* and to create awareness on important issues related to local environment and climate among the masses. Such updates were regularly shared on ARIES's social media pages as well.

ARIES e-Lecture Series 2020

People were forced to be confined to their homes during the unprecedented lockdown resulting from the pandemic. To provide an insight into the scientific research being carried out at ARIES, an online e-lecture series was organised. Total 23 lectures were delivered by scientists, engineers and research fellows covering various areas of observational/theoretical astronomy and astrophysics, astronomical instrumentation, and atmospheric sciences. The series provided an overview of how modern science is being done and a glimpse of the associated challenges in the present era. All the lectures were live streamed on social media and have accumulated over 25000 views collectively (**Figure 62**).

Figure 62. ARIES e-lecture series 2020.

Other Scientific Activities

Meetings/Workshops organised at ARIES

As a part of the celebration of Golden Jubilee Commemoration year of DST, three meetings were organised by ARIES in online mode during this year.

The first International Liquid Mirror Telescope (ILMT) workshop was conducted during 29 June - 1 July, 2020 focusing on exploring possible science cases, efficient data handling techniques and establishing a collaboration among astronomers from the countries involved in the ILMT project. It was attended by about 100 participants.

Figure 63. The first ILMT workshop.

ARIES and Hemvati Nandan Bahuguna Garhwal Central University (HNBGU) Srinagar, Pauri Garhwal, jointly organised an international conference *Aerosol Air Quality, Climate Change and Impact on Water Resources and Livelihoods in the Greater Himalayas* during 14-16 September, 2020. About 185 participants attended the conference.

Figure 64. International conference on aerosol air quality and climate change.

A one day national webinar - *An Overview of Climate Change over South Asia: Observations and Modelling Perspectives* - was organised on 9 December, 2020 as a tribute to the late renowned meteorologist and climate scientist Prof. G. B. Pant, former Director, IITM, Pune.

Talk/Poster presentations delivered by ARIES members

Alok C. Gupta

An introduction to active galactic nuclei, 19 June, 2020, ARIES, Nainital. *(e-lecture series)*

Multi-wavelength variability and QPOs in blazars, 24 August, 2020, ARIES, Nainital. *(colloquium)*

High energy emission and QPOs in blazars, 6-8 November, 2020, China - India workshop on High Energy Astrophysics, Fudan University, Shanghai, China. *(invited)*

Indranil Chattopadhyay

The intimate relationship of physics with mathematics, 15 October, 2020, Amity University ,Uttar Pradesh. *(invited)*

Classical Mechanics: from Newtonian to special relativity, 28 December, 2020, Amity University, Uttar Pradesh. *(invited)*

Accretion ejection system around black holes and the emergent spectra, 28 January – 4 February 2021, 43rd COSPAR Scientific Assembly. *(invited)*

Two temperature solution and emergent spectra from compact objects, 28 January – 4 February 2021, 43rd COSPAR Scientific Assembly. *(solicited)*

Numerical simulation of accretion and jets around compact objects, 18-23 February, 2021, The 39th Meeting of the Astronomical Society of India. *(invited)*

Pair production in accretion discs around black holes, 18-23 February, 2021, The 39th Meeting of the Astronomical Society of India. *(invited)*

J. C. Pandey

Stellar structure and evolution, 7 May, 2020, ARIES, Nainital. *(e-lecture series)*

Stellar variability studies with ILMT, 29 June - 1 July, 2020, The first ILMT workshop, ARIES, Nainital. *(invited)*

Accretion flows in intermediate polars, 27 November, 2020, IISF - 2020, ARIES, Nainital. *(invited)*

X-ray activities of three rapidly rotating active stars by AstroSat, 19-21 January 2021, Conference on 5 years of *AstroSat*, ISRO, Bengaluru. *(talk)*

Colliding stellar winds in Wolf-Rayet binaries, 18-23 February, The 39th Meeting of the Astronomical Society of India. *(invited)*

X-ray activities of rapidly rotating active stars, 2-4 March, 2021, Cambridge Workshops of Cool Stars, Stellar Systems and the Sun, CfA. *(poster)*

AstroSat observations of long-duration X-ray superflares on active M-dwarf binary EQ Peg, 2-4 March, 2021, Cambridge Workshops of Cool Stars, Stellar Systems and the Sun, CfA. *(poster)*

Kuntal Misra

Energetic cosmic explosions in the Universe, 10 July, 2020, ARIES, Nainital. *(e-lecture series)*

Assessment of supernova explosion parameters using optical observations, 29-30 September 2020, HCT@20, IIA Bengaluru. *(invited)*

Working Group for Gender Equity (WGGE) of the Astronomical Society of India (ASI), 06-09 October, 2020, The second Shaw-IAU workshop, European Continent. *(poster)*

Transients in the UV regime, 18 February, 2021, Ultra-Violet Space Astronomy: UVIT and Beyond workshop, The 39th Meeting of the Astronomical Society of India. *(invited)*

Manish Naja

Trace species over the central Himalayan region: role of regional sources, 23-24 August, 2020, Northern India Air Pollution Meeting, online hosted by JAMSTEC, Japan. *(talk)*

Update on ARIES ST-RADAR, 21 August, 2020, Jointly organised by Radar team in India. *(talk)*

Ozone layer and ozone pollution: issues, challenges and future ahead, 16 September, 2020, World Ozone Day talk, IMSA, ISRS, ISG, Ahmedabad Chapter. *(invited)*

Trace gases studies over the central Himalayas and surrounding regions, 14-17 September, 2020, Online International Conference on Aerosol Air Quality, Climate Change and Impact on Water Resources and Livelihoods in the Greater Himalayas, ARIES, Nainital. *(invited)*

Trace gases over the Arabian Sea, the Bay of Bengal and the Indian Ocean, 30 September, 2020, Online meeting on air-sea exchange science in the Indian Ocean (IO), by SOLAS IPO, Germany. *(invited)*

Air pollution and climate change studies over the Himalayas, 27 November, 2020, IISF-2020, ARIES, Nainital. *(invited)*

Good ozone and bad ozone: past, present and future, 16 September, 2020, World Ozone Day talk, School of Environment & Natural Resources, Doon University. *(invited)*

Air pollution & climate change studies at ARIES, 28 December, 2020, Astro with ARIES, lecture series by IIT Roorkee and Indian Physics Association. *(invited)*

Narendra Singh

Climatological aspects of Himalayan region: An emphasis to the transport of pollutants, 14-17 September, 2020, International Conference on Aerosol Air Quality, Climate Change and Impact on Water Resources and Livelihoods in the Greater Himalayas, ARIES, Nainital. *(talk)*

Neelam Panwar

Photometric and Gaia DR2 study of the young cluster Berkeley 59, 02-06 November, 2020, IIA, Bengaluru. *(poster)*

Star formation and evolution of the HII region Sh2-112, 18-23 February, 2021, The 39th Meeting of Astronomical Society of India. *(poster)*

Samaresh Bhattacharjee

Technical implementation of first central Himalayan VHF ST Radar at ARIES, Nainital, 14-17 December, 2020, Tropmet 2020 National Symposium on Weather and climate services over mountainous regions. *(talk)*

Santosh Joshi

A glimpse of the optical Astronomy, 07 August, 2020, Central University, Gaya, Bihar, India. *(invited)*

Saurabh

Star formation studies, 27 November, IISF - 2020, ARIES, Nainital. *(invited)*

Multi-wavelength studies of star-forming regions, 22-26 March, 2021, IIA, Bengaluru. *(invited)*

S. B. Pandey

India's participation to the thirty meter telescope project, 6 July, 2020, ARIES. *(e-lecture series)*

2.0m HCT: afterglow observations of GRBs and key findings, 29-30 September, 2020, HCT@20, IIA, Bengaluru. *(invited)*

Prompt emission properties of ULGRBs and SNe connections, 8 November, 2020, China-India workshop on High Energy Physics, China. *(talk)*

Tarun Bangia

Water harvesting initiative for an astronomical site in central Himalayas, 14-16 September, 2020, International Conference on Aerosol Air Quality, Climate Change and Impact on Water Resources and Livelihoods in the Greater Himalayas, ARIES, Nainital. *(talk)*

Sustaining mechanical systems of 3.6m optical telescope at Devasthal, India, 14-18 December, 2020, SPIE Symposium on Astronomical Telescopes+ Instrumentation digital forum. *(poster)*

Telescope enclosures at ARIES, 18-23 February, 2021, The 39th Meeting of Astronomical Society of India. *(poster)*

T. S. Kumar

CCDs in Astronomy, 26 May, 2020, ARIES, Nainital. *(e-lecture series)*

Manipulation of CCD controller to achieve different modes of operation, 29 June - 1 July, 2020, The first ILMT workshop, ARIES, Nainital. *(talk)*

Active compensation of disturbances using dual motors

in telescope motion control, 25-26 September, 2020, IEEE First International Conference on Smart Technologies for Power, Energy and Control (STPEC), VNIT, Nagpur. (*talk)*

Adaptive optics for ground based telescopes, 12 November, 2020, CU Applied optics webinar, Calcutta University, Calcutta. *(invited)*

Precision imaging using large ground based modern optical telescopes, 14 December, 2020, 5 day online AICTE sponsored ATAL FDP on Robotics (Emerging Research Trends), RAIT Mumbai. *(invited)*

U. C. Dumka

Atmospheric aerosols over Himalayas and types and transport dynamics, 26 August, 2020, Koneru Lakshmana Education Foundation (KLEF), Vijayawada, Andhra Pradesh. *(invited)*

Direct and indirect radiative forcing and the significance of the aerosol measurements from Nainital, a high altitude location, in the central Gangetic Himalayan region, 14-17 September, 2020, International Conference on Aerosol Air Quality, Climate Change and Impact on Water Resources and Livelihoods in the Greater Himalayas, ARIES, Nainital. *(invited)*

The role of the intertropical discontinuity region and the heat-low in dust emission and transport over the Thar Desert - India: a pre-monsoon case study, 18 October, 2020, ARIES, Nainital *(seminar)*.

Vaibhav Pant

Thermodynamics of Coronal Mass Ejections, 18-23 February, 2021, The 39th Meeting of Astronomical Society of India. *(invited)*

Forward modelling of MHD waves in the solar atmosphere, 01-04 March, 2021, IIA, Bengaluru. *(invited)*

Virendra Yadav

Aryabhatta Research Institute of Observational Sciences; 3.6m Devasthal Optical Telescope; 1.3m Devasthal Fast Optical Telescope; 104cm Sampurnanand Telescope; 15cm Solar Telescope at ARIES and ARIES Science Popularization & Public Outreach Program, 18-23 February, 2021, The 39th Meeting of Astronomical Society of India. *(poster)*

Staff Welfare Measures

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 have empanelled SAI Hospital, Haldwani (Dist.- Nainital), Brijlal Hospital, Haldwani (Dist. - Nainital) and Krishna Hospital and Research Centre, Haldwani (Dist.- Nainital) on cashless basis through which expenses are reimbursed as per CGHS rates. Two doctors are engaged by ARIES who visits the institute twice a week. Facilities like rest bed and medical equipments are readily available in the dispensary.

Canteen Facility

The institute has a canteen run by ARIES at no loss no benefit basis. Meals, snacks and beverages are prepared in hygienic condition in the canteen 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.

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 this scheme.

Reservation Policy

The institute is following post based rosters for affecting the prescribed percentage of reservations to SC/ST/OBC in all new recruitments as per Government of India rules.

Official Language Policy

Proactive efforts are being made to ensure successful implementation of the official language. A nodal officer has been nominated for implementation of official language as per rules and directions issued by Govternment of India from time to time.

Prevention of Sexual Harassment at Work Place

Necessary steps and guidelines are laid out in compliance of the instructions on the subject. No complaints have been received during the year.

Implementation of Right to Information Act

The provisions of RTI Act have been implemented.

Welfare committee initiatives

The welfare committee at ARIES has taken several initiatives for the welfare of the staff. Step by step procedure is adopted by the team to maintain a clean and green campus. Exhaustive cleanliness drive and segregation of waste are being regularly followed. Awareness about segregation at source and composting is being spread in ARIES (**Figure 65**). Many other activities are taken up from time to time for a sustainable and healthy environment.

Figure 65. Composting of organic waste.

Members of ARIES

Academic (22)

Dipankar Banerjee *(Director)*

Alok C. Gupta
Brijesh Kumar
Jeewan C. Pandey
Narendra Singh
Santosh Joshi
Sneh Lata
Vaibhav Pant
Wahab Uddin
Amitesh Omar
Haritma Gaur *(Inspire Faculty Fellow)*
Kuntal Misra
Neelam Panwar
Shashi Bhushan Pandey
Suvendu Rakshit
Vaidehi S. Paliya
Yogesh C. Joshi
Brajesh Kumar *(Project Scientist)*
Indranil Chattopadhyay
Manish Naja
Ramakant Singh Yadav
Saurabh
Umesh C. Dumka
Virendra Yadav

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 (12)

Ravinder Kumar *(Registrar)*
Bharat Singh *(Asstt. Registrar)*

Abhishek Kumar Sharma
Himanshu Vidhyarthi
Praveen Solanki
Virendra Kumar Singh
Gaurav Meena
Mahesh Chandra Pande
Rajeev Kumar Joshi
Hansa Karki
Manjay Yadav
Rajendra Prasad Joshi

Scientific and Technical (29)

Abhijit Misra
Arjun Singh
C. Arjuna Reddy
Harish Chandra Tewari
Kanhaiya Prasad
Manoj Kumar Mahto
Pavan Tiwari
Rajdeep Singh
Ravindra Kumar Yadav
Uday Singh
Anant Ram Shukla
Ashok Kumar Singh
Darwan Singh Negi
Hemant Kumar
Kanti Ram Maithani
Naveen Chandra Arya
Pradip Chakarborty
Rajan Pradhan
Sanjay Kumar Singh
Vinod Kumar Sah
Anil Kumar Joshi
Babu Ram
G. N. Pathak *(till 04-11-2020)*
Javed Alam
Lalit Mohan Dalakoti
Nitin Pal
Prashant Kumar
Rajendra Prasad
Srikant Yadav

Laboratory Assistant/Attendants (9)

Ashok
Mohan Singh Rana
Shyam Giri *(till 31.07.2020)*
Basant Ballabh Bhatt
Rakesh Kumar
Shyam Lal
L. S. Kanwal *(till 31.08.2020)*
Ramdayal Bhatt
Suresh Chandra Arya

Post Doctoral Fellows/Research Associate (12)

Aarti Fulara
Bikram Pradhan *(till 10-12-2020)*
Manjunath Hegde
Avinash Singh *(till 31-03-2021)*
Kaushal Sharma
Pankaj Kushwaha
Avrajit Bandyopadhyay
M. Syed Ibrahim
Rakesh Mazumder

Samrat Sen | Sindhu Pandey | Varun

Research Scholars (55)

Aayushi Verma
Alaxender Panchal
Amit Kumar
Arpan Ghosh
Atul Pathania *(till 19-01-2021)*
Bibhuti Kumar Jha
Dimple
Jayanand Maurya
Krishan Chand
Mrinmoy Sarkar
Nitin Vashishtha
Priyanka Jalan
Rahul
Raya Dastidar
Sanjit Debnath
Shivangi Pandey
Tushar Tripathi
Vikas Rawat
Vivek Kr. Jha
Aditya Jaiswal
Amar Aryan
Anjasha Gangopadhyay *(till 23-03-2021)*
Arvind Kumar
Bharti Arora
Devanand PU
Gurpreet Singh
Jaydeep Singh
Kuldeep Singh
Naveen Dukiya
Pankaj Sanwal
Priyanka Srivastava
Rahul Gupta
Ritesh Patel
Sapna Mishra
Shubham Kishore
Upasna Baweja
Vineet Ojha
Akanksha Rajput
Amit Kumar
Ankur Ghosh
Ashwini Pandey *(till 06-01-2021)*
Bhavya
Dibya Kirti Mishra
Gaurav Singh
Jyoti
Mahendra C. Rajwar
Nikita Rawat
Prajjwal Singh Rawat
Rajkishore Joshi
Rakesh Pandey
Sadhana Singh
Shilpa Sarkar
Tirthendu Sinha
Vibhore Negi
Vinit Dhiman

New members at ARIES

Dr. Brajesh Kumar
Project Scientist

Dr. Suvendu Rakshit
Scientist 'C'

Dr. Vaibhav Pant
Scientist 'C'

Dr. Vaidehi S. Paliya
Scientist 'C'

Dr. Virendra Yadav
Scientist 'B'

Mr. Gourav Meena
LDC

Post Doctoral Fellows

Dr. Aarti Fulara

Dr. Avinash Singh

Dr. Avrajit Bandopadhyay

Dr. Bikram Pradhan

Dr. Kaushal Sharma

Dr. Rakesh Mazumder

Dr. Samrat Sen

Dr. Sindhu Pandey

Dr. Varun

Research Scholars


Mr. Amit Kumar


Ms. Aayushi Verma


Mr. Devanand P U


Ms. Dibya Kirti Mishra


Ms. Jyoti Sheoran

Mr. Mirnmoy Sarkar


Mr. Naveen Dukiya


Mr. Sanjit Debnath


Ms. Shivangi pandey


Ms. Upasna Baweja

Abbreviations

A&A	Astronomy & Astrophysics
AC	Academic Committee
AD-FOSC	ARIES Devasthal Faint Object Spectrograph & Camera
AGN	Active Galactic Nuclei
AGU	Auto Guiding Unit
AIMPOL	ARIES Imaging Polarimeter
ARISS	Adapter Rotator Instrument Support Structure
ASTRAD	ARIES Stratosphere Troposphere Radar
ATAL	Asian Tropopause Aerosol Layer
BARC	Bhabha Atomic Research Centre
BC	Black Carbon
BD	Brown Dwarfs
CCD	Charged Coupled Device
CCTV	Closed-Circuit Television
CGHS	Central Government Health Scheme
CME	Coronal Mass Ejection
CMS	Content Management System
CNC	Computerized Numerical Control
CPU	Central Processing Unit
CSM	Circum Stellar Material
DFOT	Devasthal Fast Optical Telescope
DOT	Devasthal Optical Telescope
DOMU	DOT Operation, Maintenance and Upgradation
DTAC	DOT Time Allotment Committee
EBC	Equivalent Black Carbon
EBs	Eclipsing Binary Stars
EC	Elemental Carbon
FPOM	Fold Pick Off Mirror
FWHM	Full Width at Half Maximum
GATE	Graduate Aptitude Test in Engineering

GPU	Graphics Processing Unit
GMRT	Giant Metrewave Radio Telescope
GPS	Global Positioning System
GRB	Gamma Ray Burst
GUI	Graphical User Interface
HCT	Himalayan Chandra Telescope
IGP	Indo-Gangetic Plains
IIA	Indian Institute of Astrophysics
IIT	Indian Institute of Technology
ILMT	International Liquid Mirror Telescope
INOV	Intra-Night Optical Variability
INSIST	Indian Spectroscopic and Imaging Space Telescope
IR	Infrared
ISM	Interstellar Medium
IVT	Instrument Verification Time
JEST	Joint Entrance Screening Test
JRF	Junior Research Fellow
KRC	Knowledge Resource Centre
LAN	Local Area Network
LiDAR	Light Detection And Ranging
MKIR	Mauna Kea Infrared
MoU	Memorandum of Understanding
NET	National Eligibility Test
NGC	New General Catalogue
NIC	National Informatics Centre
NKN	National Knowledge Network
NLOT	National Large Optical Telescope
NLST	National Large Solar Telescope
OC	Organic Carbon
OPAC	Online Public Access Catalogue
PAH	Polycyclic Aromatic Hydrocarbons

PCB	Printed Circuit Board
PDF	Post Doctoral Fellow
PIB	Press Information Bureau
PLC	Programmable Logic Controller
PM	Particulate Matter
PMS	Pre-Main-Sequence
POM	Pick Off Mirror
QPO	Quasi-Periodic Oscillation
SAC	Scientific Advisory Committee
SDSS	Solan Digital Sky Survey
SN	Supernova
SRF	Senior Research Fellow
ST	Stratosphere Troposphere (Atmospheric Facility)
ST	Sampurnanand Telescope (Astronomical Facility)
TAC	Total Carbonaceous Aerosols
TANSPEC	TIFR-ARIES Near Infrared Spectrometer
TDG	Tidal Dwarf Galaxy
TIFR	Tata Institute of Fundamental Research
TIRCAM2	TIFR Near Infrared Imaging Camera – II
TMT	Thirty Meter Telescope
ToO	Target of Opportunity
TRM	Transmitting and Receiving Module
TTV	Transit Timing Variation
UD	Uniform Disc
UV	Ultraviolet
VHE	Very High-Energy
VPH	Volume Phase Holographic
WRF	Weather Research & Forecasting
XMM	X-ray Multi-Mirror Mission
YSO	Young Stellar Object

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENES, (ARIES)

MANORA PEAK,
NAINITAL – 263001 (UTTARAKHAND)

AUDITED FINANCIAL STATEMENTS

2020 – 2021

Audited By:

CA. Mukesh Goel, FCA
MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS
"JHURMUT", POLYSHEET, NAINITAL ROAD
HALDWANI – 263 126
(DISTT- NAINITAL, UTTARAKHAND)

PH: 05946-298920, 9719406671
E-MAIL: mukeshgoel3691@gmail.com

MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS
[CAG Empanelment No – CR2168]

POLYSHEET, NAINITAL ROAD
HALDWANI – 263126 (UK)
PH: (05946) 298920, 9719406671
Email: mukeshgoel3691@gmail.com

FORM NO.10B
[See Rule 17B]
Audit Report under section 12A (b) of the Income Tax Act, 1961
in the case of Charitable or religious or institutions
FINANCIAL YEAR 2020-2021
UDIN: 21073335AAAABC3519

We have examined the Balance Sheet of **ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES, [PAN: AAAAA8701B] as at 31ST March 2021** and the Income and Expenditure Account for the year ended on that date which are in agreement with the books of account maintained by the said Institution.

We have obtained all the information and explanations which of the best of our knowledge and belief were necessary for the purposes of the audit. In our opinion, proper books of account have been kept by the head office and the branches of the above-named institution visited by us so far as appears from our examination of the books, and proper Return adequate for the purposes of audit have been received from branches not visited by us **(the said Institute has no Branch)** subject to the comments given below.

In our opinion and to the best of our information, and according to information given to us the said accounts give a true and fair view: -

(i) In the case of the Balance Sheet of the state of affairs of the above-named institution as at 31st March 2021.
(ii) In the case of the Income and Expenditure Account, of the surplus/(deficit) of its accounting year ending on 31st March 2021.

The prescribed particulars are annexed hereto.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]
UDIN: 21073335AAAABC3519

PLACE: HALDWANI
DATED: August 31, 2021

ANNEXURE OF FORM 10B
STATEMENT OF PARTICULARS
FINANCIAL YEAR 2020-2021

I. APPLICATION OF INCOME FOR CHARITABLE OR RELIGIOUS PURPOSES:

1.	Amount of income of the previous year applied to charitable or religious purposes in India during that year.		**Rs. 33,32,91,620.50**
2.	Whether the institution has exercised the option under clause (2) of the Explanation to section 11 (1)? If so, the details of the amount of income deemed to have been applied to charitable or religious purposes in India during the previous year.		**Yes** **Rs. 2,48,28,000.00**
3.	Amount of income Accumulated or set apart for application to charitable or religious purposes, to the extent it does not exceed 15 per cent of the income derived from property held under trust Wholly for such purposes.		**Rs. 5,80,85,037.32**
4.	Amount of income eligible for exemption under section 11 (1)(c) [Give details]		**NIL**
5.	Amount of income, in addition to the amount referred to in item 3 above, accumulated or set apart for specified purposes under section 11 (2)		**Rs. 2,48,28,000.00**
6.	Whether the amount of income of mentioned in item 5 above has been invested or deposited in the manner laid down in section 11(2)(b)? If so, the details there of.		**Yes** **Rs. 2,48,28,000.00**
7.	Whether any part of the income in respect of which an option was exercised under clause (2) of the Explanation to section 11(1) in any earlier year is deemed to be income of the previous year under section 11(B)? If so, the details thereof.		**NA**
8.	Whether, during the previous year, any part of income accumulated or set apart for specified purposes under section11(2) in any earlier year: -		
	a.	has been applied for purposes other than charitable or religious purposes or has ceased to be accumulated or set apart for application there to, or	**NA**
	b.	has ceased to remain invested in any security referred to in section 11(2)(b)(i) or deposited in any account referred to in section 11(2)(b)(ii) or section 11(2) (b) (iii), or	**NA**
	c.	has not been utilized for purposes for which it was accumulated or set apart during the period for which it was to be accumulated or set apart, or in the year immediately following the expiry thereof? If so, the details thereof.	**NA**

Continued to page -2-

MUKESH GOEL & CO. Chartered Accountants HALDWANI M.9[illegible]400671

II. APPLICATION OR USE OF INCOME OF PROPERTY FOR THE BENEFIT OF PERSONS REFERRED TO IN SECTION 13 [3].

1.	Whether any part of the income or property of the institution lent, or continues to be lent, in the previous year to any person referred to in section 13(3) (hereinafter referred to in this Annexure as such person)? If so, give details of the amount, rate of interest charged and the nature of security, if any.	**No**
2.	Whether any part of the income or property of the institution was made, or continued to be made, available for the use of any such person during the previous year? If so, give details of the property and the amount of rent or compensation charged, if any.	**No**
3.	Whether any payment was made to any such person during the previous year by way of salary, allowance or otherwise? If so, give details.	**No**
4.	Whether the services of the institution were made available to any such person during the previous year? If so, give details thereof together with remuneration or compensation received, if any.	**No**
5.	Whether any share, security, or other property was purchased by or on behalf of the institution during the previous year from any such person? If so, give details thereof together with the consideration paid.	**No**
6.	Whether any share, security or other property was sold by or on behalf of the institution during the previous year to any such person? If so, the details thereof together with the consideration received.	**No**
7.	Whether any income or property of the institution was diverted during the previous year in favor of any such person? If so, give details thereof together with the amount of income or value of property so diverted.	**No**
8.	Whether the income or property of the institution was used or applied during the previous year for the benefit of any such person in any other manner? If so, give details.	**No**

III. INVESTMENT HELD AT ANY TIME DURING THE PREVIOUS YEAR(S) IN CONCERNS IN WHICH PERSONS REFERRED TO IN SECTION 13(3) HAVE A SUBSTANTIAL INTEREST.

Sl. No	Name and address of the concern	Where the concern is a company, number and class of shares held	Nominal value of the investment	Income for the investment	Whether the amount in Col. 4 exceeded 5% of the capital of the concern during the previous year-say Yes/No
	----------	----------	----------	NA	----------
	Total				

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]
UDIN: 21073335AAAABC3519

PLACE: HALDWANI
DATED: August 31, 2021

MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

POLYSHEET, NAINITAL ROAD
HALDWANI (PO – Kathgodam) - 263126
[District-Nainital, Uttarakhand]
PH: (05946) 298920, 9719406671
Email: mukeshgoel3691@gmail.com

INDEPENDENT ADUITOR'S REPORT

FINANCIAL YEAR - 2020-2021
UDIN: 21073335AAAABB6162

To,
THE REGISRAR,
ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES),
UNDER THE DEPARTMENT OF SCIENCE & TECHNOLOGY (DST),
GOVERNMENT OF INDIA, MANORA PEAK,
NAINITAL – 263001
[District – Nainital, Uttarakhand]

Dated: August 31, 2021

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, 2021**, 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 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, 2021 and its financial performance 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, 2021. These matters were addressed in the context of our audit of the financial statements as a whole, and in forming our opinion thereon, and we do not provide a separate opinion on these matters.

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MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

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 misstatement 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) The Institute, though covered u/s 51 of the CGST Act, related to TDS under GST, has not deducted tax as required by the said Act with effect from October 01, 2018. The Institute may be held responsible for non-compliance of GST Laws resulting contingent liability of the Institute in future.

***(b) During the year under audit some accounts are written-off and / or adjusted, after management's approval, to overcome the irregularities and to facilitate true and fair view of the financial statements. As per these adjustments balance of Reserves & Surplus has been reduced by Rs. 43,94,926.51.
(Annexure – III).***

(c) During the year under Audit a sum of Rs. 16,195,520.56, being the amount of excess interest returned to DST in FY – 2016-17, is written off by debiting Corpus/ Capital Fund of the Institute after management's decision considering the status of this amount as non-refundable.

(d) Fixed Assets of the Institute have not been physically verified by the management of the Institute.

(e) Fixed Asset Register, as kept by the Institute, does not present Head-wise, Item-wise and year-wise details related to Cost, Depreciation and WDV of Fixed Assets. We verified the Schedule of Fixed Assets through accounts of the Institute maintained on Computer using "Tally-ERP-9" software.

(f) During the year under Audit an addition in the Fixed Assets namely "Telescope DOT 3.6 Mt" is shown by Rs. 314,59,765.00. The payment was arranged through Letter of Credit (4 Accounts) issued by SBI for the procurement of the said asset. It is found that no such asset was received by the Institute as well as the payment was not released by the Bank in favor of the Supplier till 31st day of March 2021.

Since all these assets were not procured and use of these assets had not been started in the year under audit, no depreciation is charged on these assets.

***(g) During the year under audit accounting system is changed from CASH basis to ACCRUAL Basis. Due to this change surplus of the Institute has been increased by Rs. 11,92,613.00.
(Annexure – I)***

Further though accrual system of accounting is adopted during the FY 2020-21, transactions related to Salary and other establishment expenses as well as various recoveries out of the salary are recorded in the books of accounts on CASH basis as per management's decision.

(h) A Litigation is pending under Arbitration regarding the claim made by M/S Vidyawati Constructions, Allahabad against the Institute. The Institute has neither shown the said claim as contingent liability in its Notes on Accounts (Sch – 25) nor any provision is made for any future liability in this regard as well as for legal expenses being incurred by the Institute. Legal and other relevant expenses incurred by the Institute in this regard are being accounted for on CASH basis.

(i) Pension Fund is kept in a Bank A/C at SBI Nainital. During the year under audit the said Bank A/C is maintained on "Auto FDR (MOD) mode" and hence Bank has deducted income tax of Rs. 219,926.00 @ 20% as the PAN of the Institute was not updated in Bank's records. Since the PAN was not there, this TDS of Rs. 219,926.00 is not being reflected in Form 26AS of the Institute.

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MUKESH GOEL & CO. Chartered Accountants HALDWANI M.9719106671

(j) During the year under audit "SCRAP" of Fixed Asset Items are sold. Cost and WDV of such sold Fixed Assets, reduced/adjusted from the value of the relevant Fixed Assets due to this sale of SCRAP, is taken as certified by the management of the Institute in this regard.

(k) Cost of Institute's "LOGO" amounting Rs. 708,000.00 paid to "National Institute of Design" is shown as General Expenses in the books of accounts of FY 2020-21.

(l) Statutory liability related to FY- 2020-21 towards NPS (Employer and Employee Share) in case of FIVE employees (newly appointed in the year under audit), amounting Rs. 162,734.00, has not been deposited to NPS department as "PRAN" had not been allotted to these employees till 31st March 2021.

(m) Statutory liability towards NPS (Employer and Employee Share) in case of "Ravinder Kumar, Registrar, amounting Rs. 10,81,306.00 till 31st march 2021 has not been deposited to NPS department due to pending legal case in this regard.

(n) Value of the consumable Stocks has been taken as certified by the management of the Institute.

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 & Regulations 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 objectives are 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 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 of these financial statements.

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MUKESH GOEL & CO. HASWANI M.9716446671 Chartered Accountants

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 & in 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, 2021 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.

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MUKESH GOEL & CO. Chartered Accountants HARDWANI M.No.405871

(6) Other Matter:

Attention is drawn to the fact that the corresponding figures for the year ended March 31, 2020 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 purposes 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 MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

MUKESH GOEL & CO. HALDWANI M.9719496671 Chartered Accountants

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]
UDIN: 21073335AAAABB6162

PLACE: HALDWANI
DATED: August 31, 2021

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

ANNEXURE - I:
(Forming part of Independent Auditor's Report)

STATEMENT SHOWING EFFECT OF CHANGE IN ACCOUNTING SYSTEM
ON THE FINANCIAL STATEMENTS OF FY - 2020-2021

S. NO.	PARTICULARS	AMOUNT (Rs.)
A.	INCREASE IN EXPENDITURES	
	Provision for Expenses	-6,814,925.00
B.	DECREASE IN EXPENDITURES	
	Prepaid Expenses	4,313,763.00
C.	INCREASE IN INCOMES	
	Accrued Interest	3,693,775.00
	Net Result (Surplus)	1,192,613.00

Forming part of the Independent Auditor's Report of even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

PLACE : HALDWANI
DATED : August 31, 2021

ANNEXURE - III:

(Forming part of Independent Auditor's Report)

STATEMENT OF ADJUSTMENT ENTRIES IN RESERVES AND SURPLUS ACCOUNT

FINANCIAL YEAR 2020-2021

S. No.	Particulars	Reason of Adjustments	Debit Amount (Rs.)	Credit Amount (Rs.)
1	Project Grants	Wrongly shown as income in earlier years	1,665,000.00	-
2	Project Grants	Wrongly shown as income in earlier years	827,901.00	-
3	DFM Engineering - Performance Security	Payment of Performance security that was not shown as liability in earlier years	3,609,500.00	-
4	Associated Business Computers - Performance Security	Payment of Performance security that was not shown as liability in earlier years	54,484.00	-
5	Surya Gen Power - Performance Security	Liability of Performance Security not created at the time of actual expenditure in earlier years, now	122,500.00	-
6	Advance - INDO US Project	Adjustment of Advance	36,305.00	-
7	Legal Advance	Adjustment of Advance	50,000.00	-
8	Imperest of A K Sharma	Adjustment of Advance	27,162.00	-
	Advance of A K Sharma	Adjustment of Advance	57,333.00	-
	Advance of Kuntal Mishra (Dr)	Adjustment of Advance	21,000.00	-
	Advance of S B Pandey	Adjustment of Advance	9,708.00	-
	Advance of Snehlata	Adjustment of Advance	35,504.00	-
	Advance of N. Nanjappa	Adjustment of Advance	15,000.00	-
	Advance of Samaresh Bhattacharya	Adjustment of Advance	6,724.00	-
	Advance of T S Kumar	Adjustment of Advance	46,116.00	-
9	Kumaon Auto Sales-Creditor	Adjustment of Creditors		256,923.00
10	Princetone Instruments - Creditor	Adjustment of Creditors	-	1,390,293.00
11	Sri Balaji Crane Services - Creditor	Adjustment of Creditors	-	35,400.00
12	Devakinandan - Creditor	Adjustment of Creditors	-	4,813.00
13	Cantten Bank A/C - Balance on 01/04/2020	Canteen Transactions (Dr. / Cr.) not entered in account books through Canteen Bank A/C in earliear years. Now the Bank A/C of Canteen is created in the books of account by the balance amount in bank as on 01/04/2020.	-	396,355.49
14	EMD of Surya Gen Power	Earnest Money had been paid in earlier years but was wrongly shown as Expenditure in that year.	-	70,000.00
15	EMD of SABO System	Earnest Money had been paid in earlier years but was wrongly shown as Expenditure in that year.	-	35,000.00
	SBI (GVAX Project) A/C	Adjustment of Opening Balance	-	526.00
	Total		6,584,237.00	2,189,310.49
	Net Result - Reduction in Reserves & Surplus			4,394,926.51

Forming part of the Independent Auditor's Report of even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

BALANCE SHEET AS AT 31st MARCH 2021

(Amount in "Rupees")

S. NO	PARTICULARS	Schedule	Current Year For the year ended 31st March 2021	Previous Year For the year ended 31st March 2020
	CORPUS/ CAPITAL FUND AND LIABILITIES			
1	CAPITAL FUND	1	1,28,83,74,619.08	1,31,58,94,823.10
2	RESERVES AND SURPLUS	2	1,19,81,694.95	1,63,76,621.46
3	EARMARKED/ ENDOWMENT FUNDS	3	10,05,17,459.06	11,24,67,190.06
4	STAFF WELFARE FUND	4	35,570.50	-
5	SECURED LOANS AND BORROWINGS	5	-	-
6	UNSECURED LOANS AND BORROWINGS	6	-	-
7	DEFERRED CREDIT LIABILITIES	7	-	-
8	CURENT LIABILITIES AND PROVISIONS	8	1,58,54,543.50	43,92,869.00
	TOTAL LIABILITIES		1,41,67,63,887.09	1,44,91,31,503.62
	ASSETS			
9	FIXED ASSETS	9	1,12,25,78,812.92	1,18,79,33,893.70
10	INVESTMENTS - FROM ENDOWMENT FUNDS	10	3,02,13,163.00	2,88,83,832.00
11	INVESTMENTS - OTHERS	11	34,78,522.00	76,41,349.00
12	CURRENT ASSETS, LOANS, ADVANCES ETS.	12	26,04,93,389.17	22,46,72,428.92
13	MISCELLANEOUS EXPENDITURE (to the extent not written off or adjusted)		-	-
	TOTAL ASSETS		1,41,67,63,887.09	1,44,91,31,503.62
14	SIGNIFICANT ACCOUNTING POLICIES	24		
15	CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	25		

As per our separate Audit Report of even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

PLACE : HALDWANI
DATED : August 31, 2021

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

STATEMENT OF INCOME AND EXPENDITURE FOR THE YEAR ENDED 31st MARCH 2021

(Amount in "Rupees")

S. NO	PARTICULARS	SCH	Current Year	Previous Year
			For the year ended 31st March 2021	For the year ended 31st March 2020
	(A) INCOMES:			
1	Income from Sales/Services	13	-	-
2	Grants/Subsidies - Establishment	14	18,90,00,000.00	14,48,23,000.00
	Grants/Subsidies - Other Admin Expenses	14	6,50,00,000.00	4,02,49,000.00
3	Project Grants	14A	47,54,005.00	67,61,269.00
4	Fees/Subscriptions	15	-	-
5	Income from Investments	16	17,29,502.00	51,24,610.00
6	Income from Royalty, Publication etc.	17	-	-
7	Interest Earned	18	83,19,351.46	51,54,220.54
8	Other Income	19	73,54,159.36	19,93,058.00
9	Increase/(decrese) in stock of Finished goods and works-in-progress	20	3,56,215.62	(7,21,037.47)
	TOTAL (A)		27,65,13,233.44	20,33,84,120.07
	(B) EXPENDITURES:			
10	Establishment Expenses	21	15,37,03,782.00	12,26,30,161.00
11	Other Administrative Expenses etc.	22	6,10,68,030.87	6,20,01,887.09
12	Expenditure on Projects	23	1,35,11,189.25	86,88,228.50
13	Interest Expenditures	24	1,29,35,782.00	51,46,468.00
	TOTAL (B)		24,12,18,784.12	19,84,66,744.59
	Balance being excess of Income / (Expenditure) (A - B)		3,52,94,449.32	49,17,375.48
14	Depreciation (corresponding to Sch 9)	9	(15,61,19,132.78)	(17,67,01,494.00)
15	Transfer to Special Reserve (Specify each)		-	-
16	Transfer to / from General Reserve		-	-
	BALANCE BEING SURPLUS/(DEFICIT) CARRIED TO CORPUS/ CAPITAL FUND		(12,08,24,683.46)	(17,17,84,118.52)
18	SIGNIFICANT ACCOUNTING POLICIES	25		
19	CONTINGENT LIABILITIES AND NOTES ON ACCOUNTS	26		

As per our separate Audit Report of even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st March 2021

	SCHEDULE 1 - CORPUS/CAPITAL FUND		(Amount in Rupees)
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021 (Credit)	Previous Year For the year ended 31st March 2020 (Credit)
1	Balance as at the beginning of the year	1,31,58,94,823.10	1,42,96,64,941.62
2	Add : Contributions towards Corpus/Capital Fund	10,95,00,000.00	5,80,14,000.00
3	Add / (Deduct) : Balance of net Income / - (Expenditure) transferred from the Income and Expenditure Account	(12,08,24,683.46)	(17,17,84,118.52)
4	Add / (Deduct) : Unspent Grant	-	-
5	Add / (Deduct) : Adjustment - Excess Interest paid to DST in 2016-17	(1,61,95,520.56)	-
	BALANCE AS AT THE YEAR - END	1,28,83,74,619.08	1,31,58,94,823.10

	SCHEDULE 2 - RESERVES AND SURPLUS		(Amount in Rupees)
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021 (Credit)	Previous Year For the year ended 31st March 2020 (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 (31.03.2020)	1,63,76,621.46	-
	Additions during the year	21,89,310.49	2,13,10,632.96
	(Dedutions) during the year	(65,84,237.00)	(49,34,011.50)
	TOTAL	1,19,81,694.95	1,63,76,621.46

Annexed to the Balance Sheet of even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st March 2021

	SCHEDULE 3 - EARMARKED/ENDOWMENT FUNDS					(Amount in Rupees)	
S.NO	PARTICUALRS	Fund Wise Breakup				Current Year Total	Previous Year Total
						For the year ended 31st March 2021	For the year ended 31st March 2020
		GPF Fund	GPF Reserve	Pension Fund	Pension Reserve	(Credit)	(Credit)
A	Opening Balance of Funds	41372053.00	48,79,418.56	44236446.56	21979271.94	112467190.06	107581313.06
	Total (A)	41372053.00	4879418.56	44236446.56	21979271.94	112467190.06	107581313.06
B	Additions :						
	a) Employee's Contributions	7225900.00	-	70,120.00	-	7296020.00	6642675.00
	b) Interest Accrued	3091061.00	-	-	-	3091061.00	2890006.00
	c) Recoveries of Advances	177500.00	-	-	-	177500.00	269150.00
	d) Transferred from Reserve		-	-	-	-	9,54,355.00
	e) Interest Contribution	-	-	-	-	-	-
	f) Endowment Surplus	-	-	-	-	-	-
	g) Pension Payable	-	-	-	-	-	-
	TOTAL (B)	10494461.00	0.00	70120.00	0.00	10564581.00	10756186.00
C	Utilisation/Payments:						
	a) Capital Payments:	-		-	-	-	-
	Transferred to GPF Fund	-	-	-	-	-	9,54,355.00
	b) Revenue Payments:	-	-	-	-	-	-
	-Permanent Withdrawls		-	-	-	-	2340000.00
	-Recoverable Advances	2530000.00	-	-	-	2530000.00	36600.00
	-Retirement Payment	3226386.00	-	1,67,57,926.00	-	19984312.00	621858.00
	-Advances of Previous yrs		-	-	-	-	499100.00
	-Pension (Last year Prov)	-	-	-		-	1418396.00
	TOTAL (C)	5756386.00	-	16757926.00	-	22514312.00	5870309.00
	NET BALANCE [A + B - C]	46110128.00	4879418.56	27548640.56	21979271.94	100517459.06	112467190.06

Annexed to the Balance Sheet of even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st March 2021

	SCHEDULE 4 - STAFF WELFARE FUND		(Amount in Rupees)
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021 (Credit)	Previous Year For the year ended 31st March 2020 (Credit)
1	Balance as at the beginning of the year	-	-
2	ADD:		
	Staff Contribution Received	64,100.00	-
	Bank Interest	244.00	-
3	TOTAL STAFF WELFARE FUND VALUE (1 + 2)	64,344.00	
4	LESS:		
	Staff Welfare Expenses	28,272.00	-
	Bank Expenses	501.50	-
	TOTAL STAFF WELFARE EXPENSES (4)	28,773.50	
	BALANCE AS AT THE YEAR - END [3 - 4]	35,570.50	-

	SCHEDULE 5 - SECURED LOANS AND BORROWINGS		(Amount in Rupees)
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021 (Credit)	Previous Year For the year ended 31st March 2020 (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 MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st March 2021

	SCHEDULE 6 - UNSECURED LOANS AND BORROWINGS		(Amount in Rupees)
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021 (Credit)	Previous Year For the year ended 31st March 2020 (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 7 - DEFERRED CREDIT LIABILITIES		(Amount in Rupees)
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021 (Credit)	Previous Year For the year ended 31st March 2020 (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 MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

PLACE : HALDWANI
DATED : August 31, 2021

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

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st March 2021

	SCHEDULE 8 - CURRENT LIABILITIES AND PROVISIONS			(Amount in Rupees)	
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021		Previous Year For the year ended 31st March 2020	
		(Credit)	(Credit)	(Credit)	(Credit)
	A. CURRENT LIABILITIES:				
1	Acceptances		-		-
2	Sundry Creditors *	-	-		16,87,429.00
3	Advances Received - Scientific Meeting		-		6,676.00
4	Interest accrued but not due on:				
	a) Secured Loans /borrowings	-		-	
	b) Unsecured Loans/borrowings	-	-	-	-
5	Statutory Liabilities:				
	a) GST Reverse Charge			-	
	b) Labour Cess (March 2021)	24,948.50		-	
	c) NPS (Employee's Contribution)*	1,05,220.00		23,853.00	
	d) NPS (Employer's Contribution)*	81,367.00		-	
	e) NPS of R.Kumar (Employee Contribution)	5,40,653.00		4,02,491.00	
	f) NPS of R.Kumar (Employer Contribution)	5,40,653.00	12,92,841.50	4,02,491.00	8,28,835.00
6	Other Curent Liabilities:				
	a) Earnest Money Deposits*	43,71,000.00		3,23,115.00	
	b) Performance Security Deposits*	8,66,944.00		13,36,807.00	
	c) Other Securities - RSD -Devakinandan	4,18,879.00		-	
	d) TDS Payable *	3,71,760.00		1,95,061.00	
	e) Leave Encashment - Satish Kumar	-		14,946.00	
	f) Misc. Project Grant to be transferred (Grants received but neither allocated to project(s) nor transferred to related Bank Account(s)	16,29,920.00		-	
	g) Outstanding Expenses*	68,14,925.00		-	
	h) Group Insurance	20,715.00		-	
	i) G. N. Pathak - Pensioner	39,774.00		-	
	j) L S kanwal - Pensioner	12,071.00		-	
	k) Shyam Giri - Pensioner	7,243.00			
	l) Ratna Kumar - Fellowship	8,471.00	1,45,61,702.00	-	18,69,929.00
	TOTAL (A)		1,58,54,543.50		43,92,869.00
	B. PROVISIONS :				
1	Taxation		-		-
2	Gratuity		-		-
3	Accumulated Leave Encashment		-		-
4	Others (Specify)		-		-
	TOTAL (B)		-		-
	TOTAL (A+B)		1,58,54,543.50		43,92,869.00

* Separate List Attached.

Annexed to the Balance Sheet of even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st March 2021

SCHEDULE 9 - FIXED ASSETS

(Amount in Rupees)

S.NO.	DESCRIPTION	Rate	GROSS BLOCK					DEPRECIATION				NET BLOCK	
			Cost/valuation As at beginning of the year (01.04.2020)	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 (31.03.2021)	As at the beginning of the year (01.04.2020)	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 (31.03.2021)	As at the Current Year end (31.03.2021)	As at the Previous Year end (31.03.2020)
			(1)	(2)	(3)	(4)	5 (1+2+3-4)	(6)	(7)	(8)	9 (7+8)	10 (5-9)	(11)
1 A	**FIXED ASSETS:** **LAND:**	0%											
	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	1,42,83,508.13	20,31,836.09	-	1,63,15,344.22	1,82,86,524.78	2,03,18,360.87
	Building Non-Res (Devsthal)		2,85,27,064.00	-	-	-	2,85,27,064.00	76,02,984.63	20,92,407.94	-	96,95,392.57	1,88,31,671.43	2,09,24,079.37
	Building Non-Res (Manora Peak)		10,76,27,691.00	-	32,11,012.00	-	11,08,38,703.00	7,30,83,711.43	34,54,397.96	1,60,550.60	7,66,98,659.99	3,41,40,043.01	3,45,43,979.57
	Infrastructure Dev. (Dev Sthal)		5,00,72,786.90	-	-	-	5,00,72,786.90	2,24,80,022.29	27,59,276.46	-	2,52,39,298.75	2,48,33,488.15	2,75,92,764.61
	Infrastructure Dev. (Manora Peak)		1,60,70,946.70	-	-	-	1,60,70,946.70	84,07,788.60	7,66,315.81	-	91,74,104.41	68,96,842.29	76,63,158.10
	Roads at Devsthal		2,28,49,164.00	-	-	-	2,28,49,164.00	1,40,57,726.09	8,79,143.79	-	1,49,36,869.88	79,12,294.12	87,91,437.91
	TOTAL (B)		25,97,49,521.60	-	32,11,012.00	-	26,29,60,533.60	13,99,15,741.17	1,19,83,378.04	1,60,550.60	15,20,59,669.81	11,09,00,863.79	11,98,33,780.43
C	**Buildings - Residential**	5%											
	Guest House (Devsthal)		12,24,022.00	-	-	-	12,24,022.00	5,70,202.35	32,690.98	-	6,02,893.33	6,21,128.67	6,53,819.65
	Building Residential (Manora Peak)		3,07,19,204.60	-	-	-	3,07,19,204.60	98,80,146.33	10,41,952.91	-	1,09,22,099.24	1,97,97,105.36	2,08,39,058.27
	TOTAL (C)		3,19,43,226.60	-	-	-	3,19,43,226.60	1,04,50,348.68	10,74,643.90	-	1,15,24,992.58	2,04,18,234.02	2,14,92,877.92
D	**VEHICLES**	15%											
	Vehicle		43,03,716.10	13,59,663.00	-	-	56,63,379.10	26,18,116.03	4,56,789.46	-	30,74,905.49	25,88,473.61	16,85,600.07
	TOTAL (D)		43,03,716.10	13,59,663.00	-	-	56,63,379.10	26,18,116.03	4,56,789.46	-	30,74,905.49	25,88,473.61	16,85,600.07
E	**FURNITURE AND FIXTURES**	10%											
	Furniture & Fixture		97,43,636.70	6,34,921.00	12,34,863.00	6,334.00	1,16,07,086.70	60,96,445.50	4,27,577.82	61,743.15	65,85,766.47	50,21,320.23	36,47,191.20
	TOTAL (E)		97,43,636.70	6,34,921.00	12,34,863.00	6,334.00	1,16,07,086.70	60,96,445.50	4,27,577.82	61,743.15	65,85,766.47	50,21,320.23	36,47,191.20
F	**OFFICE EQUIPMENTS**	10%											
	Office Equipment		17,29,983.25	2,51,384.00	2,53,418.00	17,549.00	22,17,236.25	12,49,240.46	71,457.78	12,670.90	13,33,369.14	8,83,867.11	4,80,742.79
	TOTAL (F)		17,29,983.25	2,51,384.00	2,53,418.00	17,549.00	22,17,236.25	12,49,240.46	71,457.78	12,670.90	13,33,369.14	8,83,867.11	4,80,742.79
G	**COMPUTER/PERIPHERALS**	40%											
	Computer & Peripherals		4,65,44,505.40	18,10,463.00	52,20,936.00	3,29,486.00	5,32,46,418.40	4,22,30,766.12	23,17,886.51	10,44,187.20	4,55,92,839.83	76,53,578.57	43,13,739.28
	Computer Software		31,64,119.00	-	9,93,848.00	-	41,57,967.00	18,57,667.04	5,22,580.78	1,98,769.60	25,79,017.42	15,78,949.58	13,06,451.96
	TOTAL (G)		4,97,08,624.40	18,10,463.00	62,14,784.00	3,29,486.00	5,74,04,385.40	4,40,88,433.16	28,40,467.30	12,42,956.80	4,81,71,857.26	92,32,528.14	56,20,191.24
H	**ELECTRIC INSTALLATIONS**	15%											
	Electrical (Non-Consumable)		36,59,249.00	5,25,669.00	32,54,602.00	31,320.00	74,08,200.00	3,85,833.00	5,65,164.75	2,44,095.15	11,95,092.90	62,13,107.10	32,73,416.00
	Electric Instalation (Devasthal)		43,53,265.00	-	-	-	43,53,265.00	26,87,841.94	2,49,813.46	-	29,37,655.40	14,15,609.60	16,65,423.06
	Electric Instalation (Manora Peak)		1,49,83,909.72	-	-	-	1,49,83,909.72	61,84,989.93	13,19,837.97	-	75,04,827.90	74,79,081.82	87,98,919.79
	Electronic Section		91,66,239.55	-	-	-	91,66,239.55	80,30,485.80	1,70,363.06	-	82,00,848.86	9,65,390.69	11,35,753.75
	Electronic Substation-DOT 3.6 Mt		39,38,840.00	-	-	-	39,38,840.00	5,90,826.00	5,02,202.10	-	10,93,028.10	28,45,811.90	33,48,014.00
	Solar Section		6,380.79	-	-	-	6,380.79	6,380.79	-	-	6,380.79	-	-
	TOTAL (H)		3,61,07,884.06	5,25,669.00	32,54,602.00	31,320.00	3,98,56,835.06	1,78,86,357.46	28,07,381.34	2,44,095.15	2,09,37,833.95	1,89,19,001.11	1,82,21,526.60
I	**LIBRARY BOOKS**	40%											
	Library Books		5,96,88,741.50	5,625.00	3,04,235.00	525.00	5,99,98,076.50	5,44,24,596.00	21,07,698.20	60,847.00	5,65,93,141.20	34,04,935.30	52,64,145.50
	TOTAL (I)		5,96,88,741.50	5,625.00	3,04,235.00	525.00	5,99,98,076.50	5,44,24,596.00	21,07,698.20	60,847.00	5,65,93,141.20	34,04,935.30	52,64,145.50

Continued to page - 2-

MUKESH GOEL & CO. Chartered Accountants NAINWANI M.No.071406871

S.NO.	DESCRIPTION	Rate	GROSS BLOCK					DEPRECIATION				NET BLOCK	
			Cost/valuation As at beginning of the year (01.04.2020)	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 (31.03.2021)	As at the beginning of the year (01.04.2020)	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 (31.03.2021)	As at the Current Year end (31.03.2021)	As at the Previous Year end (31.03.2020)
			(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		1,24,63,96,920.00	-	3,14,59,765.00	-	1,27,78,56,685.00	59,25,58,117.82	9,80,75,820.33	-	69,06,33,938.15	58,72,22,746.85	65,38,38,802.18
	Telescope - 1.3 Mt		9,22,52,249.00	-	-	-	9,22,52,249.00	6,42,70,512.47	41,97,260.48	-	6,84,67,772.95	2,37,84,476.05	2,79,81,736.53
	Telescope		1,60,36,766.55	-	-	-	1,60,36,766.55	46,32,242.83	17,10,678.56	-	63,42,921.39	96,93,845.16	1,14,04,523.72
	Backend Instrument -Modernization		16,41,75,713.00	-	-	-	16,41,75,713.00	5,69,90,515.76	1,60,77,779.59	-	7,30,68,295.35	9,11,07,417.65	10,71,85,197.24
	Backend Instrumemt - ADFOSC		36,21,201.00	-	3,23,014.00	-	39,44,215.00	25,21,019.59	1,65,027.21	24,226.05	27,10,272.85	12,33,942.15	11,00,181.41
	Instruments		10,86,25,443.67	-	-	69,339.00	10,85,56,104.67	7,66,67,357.83	47,83,312.03	-	8,14,50,669.86	2,71,05,434.81	3,19,58,085.84
	Aluminization Plant (Devsthal)		3,95,23,736.00	-	-	-	3,95,23,736.00	1,88,92,098.63	30,94,745.61	-	2,19,86,844.24	1,75,36,891.76	2,06,31,637.37
	LIDAR Project		87,60,465.00	-	-	-	87,60,465.00	71,10,333.50	2,47,519.73	-	73,57,853.23	14,02,611.78	16,50,131.50
	Optics		4,54,597.80	-	-	-	4,54,597.80	1,15,451.79	50,871.90	-	1,66,323.69	2,88,274.11	3,39,146.01
	Telescope (Schmidt)		1,07,38,623.00	-	-	-	1,07,38,623.00	89,12,083.10	2,73,980.99	-	91,86,064.09	15,52,558.92	18,26,539.90
	Planetarium (Public Outreach)		39,18,714.00	-	-	-	39,18,714.00	26,62,463.91	1,88,437.51	-	28,50,901.42	10,67,812.58	12,56,250.09
	Projector (Public Outreach)		1,05,000.00	-	-	-	1,05,000.00	78,533.95	3,969.91	-	82,503.86	22,496.14	26,466.05
	Spectrometer		10,62,951.00	-	-	-	10,62,951.00	4,59,125.56	90,573.82	-	5,49,699.38	5,13,251.62	6,03,825.44
	Telescope (Public Out Reach)		6,07,295.00	-	-	-	6,07,295.00	4,66,634.79	21,099.03	-	4,87,733.82	1,19,561.18	1,40,660.21
	Telescope Solar		13,67,166.00	-	-	-	13,67,166.00	11,62,268.94	30,734.56	-	11,93,003.50	1,74,162.50	2,04,897.06
	ST RADAR		18,64,642.00	-	-	-	18,64,642.00	2,79,696.00	2,37,741.90	-	5,17,437.90	13,47,204.10	15,84,946.00
	ASTRAD - CSNOF-05		58,58,768.00	9,66,244.00	4,03,750.00	-	72,28,762.00	8,60,727.00	8,94,642.75	30,281.25	17,85,651.00	54,43,111.00	49,98,041.00
	Telescope Enclosure - 3.6 Mt		1,23,16,735.00	4,51,500.00	23,72,072.00	-	1,51,40,307.00	11,75,232.00	17,38,950.45	1,77,905.40	30,92,087.85	1,20,48,219.15	1,11,41,503.00
	TOTAL (J)		1,71,76,86,986.02	14,17,744.00	3,45,58,601.00	69,339.00	1,75,35,93,992.02	83,98,14,415.47	13,18,83,146.33	2,32,412.70	97,19,29,974.50	78,16,64,017.52	87,78,72,570.55
K	OTHER FIXED ASSETS	15%											
	Aluminising / Anodising		89,358.67	-	-	-	89,358.67	89,358.67	-	-	89,358.67	-	-
	Canteen Assets		35,297.00	81,721.00	1,419.00	-	1,18,437.00	2,647.00	17,155.65	106.43	19,909.08	98,527.93	32,650.00
	CCTV Camera		77,500.00	-	-	-	77,500.00	33,474.78	6,603.78	-	40,078.56	37,421.44	44,025.22
	Library Instrument		9,500.00	-	-	-	9,500.00	4,540.81	743.88	-	5,284.69	4,215.31	4,959.19
	Workshop Assets		3,10,039.45	35,917.00	3,58,449.00	-	7,04,405.45	2,45,261.46	15,104.25	26,883.68	2,87,249.38	4,17,156.07	64,777.99
	Hostel Assets		-	1,00,939.00	24,891.00	-	1,25,830.00	-	15,140.85	1,866.83	17,007.68	1,08,822.33	-
	Guest House Assets		-	1,01,086.00	3,599.00	-	1,04,685.00	-	15,162.90	269.93	15,432.83	89,252.18	-
	Project Assets		27,62,966.00	-	-	-	27,62,966.00	4,14,445.00	3,52,278.15	-	7,66,723.15	19,96,242.85	23,48,521.00
	TOTAL (K)		32,84,661.12	3,19,663.00	3,88,358.00	-	39,92,682.12	7,89,727.72	4,22,189.46	29,126.85	12,41,044.03	27,51,638.09	24,94,933.40
	TOTAL OF CURRENT YEAR (1)		2,27,97,97,410.35	63,25,132.00	4,94,19,873.00	4,54,553.00	2,33,50,87,862.35	1,11,73,33,421.65	15,40,74,729.63	20,44,403.15	1,27,34,52,554.43	1,06,16,35,307.92	1,16,24,63,988.70
	TOTAL OF PREVIOUS YEAR (1)		2,11,81,41,037.34	12,26,15,888.00	3,90,56,330.00	15,844.99	2,27,97,97,410.35	94,06,31,927.65	17,29,77,944.00	37,23,550.00	1,11,73,33,421.65	1,16,24,63,988.70	1,17,75,09,109.70
2	CAPITAL WORK-IN-PROGRESS												
A	ILMT - 4M		2,54,69,905.00	-	-	-	2,54,69,905.00	-	-	-	-	2,54,69,905.00	2,54,69,905.00
B	Advance-CWIP (Const Devasthal)		-	-	2,94,00,000.00	-	2,94,00,000.00	-	-	-	-	2,94,00,000.00	-
C	Advance Rural Works Department		-	-	60,73,600.00	-	60,73,600.00	-	-	-	-	60,73,600.00	-
	TOTAL (2)		2,54,69,905.00	-	3,54,73,600.00	-	6,09,43,505.00	-	-	-	-	6,09,43,505.00	2,54,69,905.00
	GRAND TOTAL (1 + 2)		2,30,52,67,315.35	63,25,132.00	8,48,93,473.00	4,54,553.00	2,39,60,31,367.35	1,11,73,33,421.65	15,40,74,729.63	20,44,403.15	1,27,34,52,554.43	1,12,25,78,812.92	1,18,79,33,893.70

Annexed to the Balance Sheet of even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]
PLACE : HALDWANI
DATED : August 31, 2021

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st March 2021

	SCHEDULE 10 - INVESTMENTS FROM EARMARKED/ENDOWMENT FUNDS		(Amount in Rupees)
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021 (Debit)	Previous Year For the year ended 31st March 2020 (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)	3,02,13,163.00	2,88,83,832.00
	b) FDR (Pension Fund A/C) with Scheduled Bank (UBI)	-	-
	c) Interest Accrued	-	-
	TOTAL	3,02,13,163.00	2,88,83,832.00

	SCHEDULE 11 - INVESTMENTS - OTHERS		(Amount in Rupees)
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021 (Debit)	Previous Year For the year ended 31st March 2020 (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)	22,71,279.00	64,92,906.00
	b) FDR (ISRO Project) with Scheduled Bank (SBI)	12,07,243.00	11,48,443.00
	c) Interest Accrued	-	-
	TOTAL	34,78,522.00	76,41,349.00

Annexed to the Balance Sheet of even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st March 2021

	SCHEDULE 12 (A) - CURRENT ASSETS, LOANS, ADVANCES ETC.			(Amount in Rupees)	
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021		Previous Year For the year ended 31st March 2020	
		(Debit)	(Debit)	(Debit)	(Debit)
	A. CURRENT ASSETS				
1	**Inventories:**				
	a) Finished Goods		-		-
	b) Work in Progress		-		-
	c) Consumables				
	-Stores and Spares	27,00,968.39		24,02,476.56	
	-Stationary	6,54,432.61		4,73,805.32	
	-Computer Accessories	14,68,259.62		14,90,472.92	
	-Fuel (POL)	1,96,766.49	50,20,427.11	2,97,456.69	46,64,211.49
2	**Sundry Debtors:**				
	a) Debts Outstanding > six months	-		-	
	b) Others	-	-	-	-
3	**Cash balances in hand** (including cheques/drafts)		-		18,608.00
4	**Bank Balances:**				
	a) With Scheduled Banks:				
	Current Accounts	-		-	
	Deposit Accounts (LC) *	-		18,33,052.00	
	Savings Account *				
	-Director A/C	14,27,01,221.55		15,50,29,872.06	
	-Pension Fund A/C	6,53,45,517.72		7,58,206.72	
	-GPF A/C	1,18,53,494.30		98,15,230.30	
	-Canteen A/C	1,63,062.99		-	
	-Staff Welfare Fund A/C	35,570.50		-	
	-Project Bank A/Cs	1,45,42,299.00	23,46,41,166.06	1,64,50,245.79	18,38,86,606.87
	b) With Non-Scheduled Banks:		-		-
5	Post Office-Savings Accounts		-		-
	TOTAL (A)		23,96,61,593.17		18,85,69,426.36

*** Separate List Attached.**

Annexed to the Balance Sheet of even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

SCHEDULES FORMING PART OF BALANCE SHEET AS AT 31st March 2021

	SCHEDULE 12 (B) - CURRENT ASSETS, LOANS, ADVANCES ETC.			(Amount in Rupees)	
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021		Previous Year For the year ended 31st March 2020	
		(Debit)	(Debit)	(Debit)	(Debit)
	B. Loans, Advances & Other Assets				
1	**Loans:**				
	a) Staff *	38,28,215.00		43,71,555.00	
	b) Others (specify)	-	38,28,215.00	-	43,71,555.00
2	**Advances and other amounts** (recoverable in cash or in kind)				
	a) On Capital Accounts	-		-	
	b) Pre-paid Expenses *	43,13,763.00		-	
	c) Others *	89,96,043.00	1,33,09,806.00	3,13,20,403.56	3,13,20,403.56
3	**Income Accured On:**				
	a) Investments - Endowment Funds			-	
	i) FDR Interest (GPF A/C)	2,40,803.00		2,75,690.00	
	ii) FDR Interest (Pension Fund A/C)	8,63,933.00	11,04,736.00	-	2,75,690.00
	b) Investments - Others			-	
	i) FDR Interest (ST RADAR Project)	36,760.00		1,35,354.00	
	ii) FDR Interest (ISRO Project)	17,694.00	54,454.00	-	1,35,354.00
	c) Loans and Advances	-		-	
	d) Others (Specify):-				
	i) Interest on Project Bank A/Cs	59,459.00		-	
	ii) Interest on Saving Bank A/Cs	24,75,126.00	25,34,585.00	-	-
4	Claims Receivable		-		-
	TOTAL (B)		2,08,31,796.00		3,61,03,002.56
	TOTAL (A+B)		26,04,93,389.17		22,46,72,428.92

*As Per Separate List Attached

Annexed to the Balance Sheet of even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st March 2021

	SCHEDULE 13 - INCOME FROM SALES/SERVICES		(Amount in Rupees)
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021 (Credit)	Previous Year For the year ended 31st March 2020 (Credit)
1	Income from Sales		
	a) Sale of Finished Goods	-	-
	b) Sale of Raw Material	-	-
	c) Sale of Scraps	-	-
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	-	-

	SCHEDULE 14 - GRANTS/SUBSIDIES		(Amount in Rupees)
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021 (Credit)	Previous Year For the year ended 31st March 2020 (Credit)
1	Central Government Grants:		
	-Grant in aid "General"	6,50,00,000.00	4,02,49,000.00
	-Grant in aid "Salary"	18,90,00,000.00	14,48,23,000.00
2	State Government Grants	-	-
3	Government Agencies	-	-
4	Others (specify)	-	-
	TOTAL	25,40,00,000.00	18,50,72,000.00

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

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st March 2021

	SCHEDULE 14A - PROJECTS GRANTS	(Amount in Rupees)	
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021 (Credit)	Previous Year For the year ended 31st March 2020 (Credit)
1	Central Government Grants:		
	Project Grants Received:-		
	a) Project Grant - DST / IMRCD / BRICS / 2017G	13,83,200.00	-
	b) Project Grant - DST / INSPIRE FACULTY 13/2017	38,53,333.00	-
	c) Project Grant - DST / INT / BELG / P-09/2017	8,27,901.00	-
	d) Project Grant - DST / INSPIRE / FELLOWSHIP	-	4,21,760.00
	e) Project Grant - DST / INT / POL / P-19 / 2016	-	3,68,608.00
	f) Project Grant - DST / INT / THAI / P-15	-	2,55,000.00
	g) Project Grant - EMR / 2016 / 001723	-	6,00,000.00
	h) Project Grant - INT / AUS / BMWF / P-14	-	4,33,000.00
	i) Project Grant - ISRO GBP	3,00,000.00	20,00,000.00
	j) Project Grant - UCOST	-	1,90,000.00
	k) Other Project Grants	54,571.00	24,92,901.00
2	State Government Grants	-	-
3	Government Agencies	-	-
4	Others (specify)	-	-
	TOTAL	64,19,005.00	67,61,269.00

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

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st March 2021

	SCHEDULE 15 - FEES/SUBSCRIPTIONS		(Amount in Rupees)
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021 (Credit)	Previous Year For the year ended 31st March 2020 (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 MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st March 2021

	SCHEDULE 16 - INCOME FROM INVESTMENTS						
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 2021	For the year ended 31st March 2020	For the year ended 31st March 2021	For the year ended 31st March 2020	For the year ended 31st March 2021	For the year ended 31st March 2020
		(Credit)	(Credit)	(Credit)	(Credit)	(Credit)	(Credit)
1	Interest	-	-	-	-	-	-
2	Dividends:	-	-	-	-	-	-
3	Rents	-	-	-	-	-	-
4	Others (Specify)					-	-
	-Interest on FDR (GPF A/C)	1,399,403.00	1,752,415.00	-	-	1,399,403.00	1,752,415.00
	-Interest on FDR (Pension Fund A/C)	-	2,680,137.00	-	-	-	2,680,137.00
	-Interest on FDR (ISRO Project A/C)	-	-	76,494.00	298,434.00	76,494.00	298,434.00
	-Interest on FDR (ST RADAR Project)	-	-	253,605.00	393,624.00	253,605.00	393,624.00
	TOTAL	1,399,403.00	4,432,552.00	330,099.00	692,058.00	1,729,502.00	5,124,610.00
	TRANSFFRRED TO INVESTMENTS	1,399,403.00	4,432,552.00	330,099.00	692,058.00	1,729,502.00	5,124,610.00

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

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK. NAINITAL
SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st March 2021

	SCHEDULE 17 - INCOME FROM ROYALTY, PUBLICATION ETC.			(Amount in Rupees)	
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021		Previous Year For the year ended 31st March 2020	
1	Income from Royalty	-	-	-	-
2	Income from Publications	-	-	-	-
3	Others (specify)	-	-	-	-
	TOTAL	-	-	-	-

	SCHEDULE 18 - INTEREST EARNED			(Amount in Rupees)	
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021		Previous Year For the year ended 31st March 2020	
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)	3,37,423.00		2,39,020.00	
	-Pension Fund A/C (SBI - 311)	11,65,817.00		2,213.00	
	-Pension Fund A/C (UBI - 535)	21,194.00		96,222.00	
	-Project Bank A/Cs (SBI & UCO Bank)	5,77,675.46		4,28,509.50	
	-Director's Bank A/C (SBI - 253)	60,41,409.00		37,96,504.00	
	-LC Bank A/Cs	5,570.00		4,79,294.04	
	-Canteen Bank A/Cs	6,615.00		-	
	b) With Non-Scheduled Banks	-		-	
	c) Others	-	81,55,703.46	-	50,41,762.54
3	On Loans:				
	a) Employees/Staff				
	-HBA Interest	72,720.00		66,660.00	
	-Car Advance Interest	52,848.00		31,000.00	
	-Computer Advance Interest	4,500.00		7,520.00	
	-M.Cycle Advance Interest	500.00		7,278.00	
	b) Others - Intt on Income Tax Refund	33,080.00	1,63,648.00	-	1,12,458.00
	TOTAL		83,19,351.46		51,54,220.54

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

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st March 2021

	SCHEDULE 19 - OTHER INCOMES			(Amount in Rupees)	
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021		Previous Year For the year ended 31st March 2020	
		(Credit)	(Credit)	(Credit)	(Credit)
1	Profit on Sale/disposal of Assets	6,07,419.00	6,07,419.00		-
2	Export Incentives realized		-		-
3	Fees for Miscellaneous Services:				
	a) Electricity Charges	4,14,356.25		3,19,621.00	
	b) Medical Contribution	28,93,850.00		-	
	c) Telephone Charges	-		91.00	
	d) Water Charges	1,09,024.25		85,164.00	
	e) House License Fees	3,97,622.00	38,14,852.50	4,16,731.00	8,21,607.00
4	Miscellaneous Income:				
	a) Guest House rent	274.00		8,76,903.00	
	b) Hostel/Shop rent	2,47,704.00		66,500.00	
	c) EMD Security Forfeited	-		60,000.00	
	d) Project Overhead Charges	2,40,000.00		1,25,000.00	
	e) RTI Receipts	1,404.00		1,794.00	
	f) Notice Period Income	-		26,823.00	
	g) Canteen Receipts (Food Bill)	19,93,740.86		-	
	h) ILMT Project (Excess Received)	4,40,424.00		-	
	i) Electrical Penalty	2,400.00		-	
	j) Other Incomes	-		14,431.00	
	k) Recovery of TA Advance	331.00	29,26,277.86	-	11,71,451.00
5	Prior Period Incomes				
	a) Interest on UBI (Pension Fund) Bank A/C		5,610.00		-
	TOTAL		73,54,159.36		19,93,058.00

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

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st March 2021

	SCHEDULE 20 - INCREASE/(DECREASE) IN INVENTORIES			(Amount in Rupees)	
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021		Previous Year For the year ended 31st March 2020	
		(Credit)	(Credit)	(Credit)	(Credit)
1	Closing stock				
	-Finished Goods	-		-	
	-Work-in-progress	-		-	
	-Consumables	50,20,427.11	50,20,427.11	46,64,211.49	46,64,211.49
2	Less: Opening Stock				
	-Finished Goods	-		-	
	-Work-in-progress	-		-	
	-Consumables	46,64,211.49	46,64,211.49	53,85,248.96	53,85,248.96
	NET INCREASE/(DECREASE) [1-2]		3,56,215.62		(7,21,037.47)

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

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st March 2021

	SCHEDULE 21 - ESTABLISHMENT EXPENSES*		(Amount in Rupees)
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021 (Debit)	Previous Year For the year ended 31st March 2020 (Debit)
1	Salaries and Wages	10,22,14,646.00	7,97,05,160.00
2	Allowances and Bonus	1,77,68,826.00	1,72,55,916.00
3	Contribution to NPS	65,18,669.00	50,34,904.00
4	Others (specify)		
	-Medical Expenses	31,64,924.00	29,58,422.00
	-Fellowship	2,03,68,663.00	1,39,34,804.00
	-Leave Encashment	7,40,493.00	4,01,683.00
	-Leave Travel Concession	83,879.00	11,14,977.00
	-Special Cash Package Expenses	14,05,487.00	-
	-Reimbursement of Tuition Fees	14,38,195.00	22,24,295.00
	TOTAL	15,37,03,782.00	12,26,30,161.00

*As per separate list attached.

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

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st March 2021

	SCHEDULE 22 - OTHER ADMINISTRATIVE EXPENSES		(Amount in Rupees)
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021 (Debit)	Previous Year For the year ended 31st March 2020 (Debit)
1	Repair & Maintenance (Minor Works) *	39,16,783.00	23,09,800.00
2	Consumable Expenses *	32,47,017.50	33,11,275.79
3	Other Administrative Expenses *	76,93,070.00	62,69,264.00
4	Meeting Expenses *	2,08,642.00	12,02,913.00
5	AMC Expenses *	11,57,471.00	12,95,039.17
6	Prior Period Expenses *	9,67,312.00	3,21,446.22
7	Travelling Expenses	31,46,151.00	80,32,273.00
8	Conveyance Expenses	13,02,952.00	10,01,840.00
9	POL (Fuel) Expenses	19,19,300.00	27,02,364.00
10	Custom Duty / Custom Clearance Charges	1,21,253.62	8,56,994.00
11	Contract Salary	42,83,180.00	5,71,338.00
12	Security Expenses	66,57,269.00	1,84,25,412.00
13	Electricity Expenses	55,55,200.00	54,76,837.00
14	Legal Fee / Professional Fee/ Consultance Charges	13,26,700.00	2,34,089.00
15	Library Expenses (Journals)	47,47,117.81	1,09,488.00
16	Cleaning Work Expenses	32,25,209.00	20,63,834.00
17	ASTRAD Annual License Fee	1,80,250.00	7,21,000.00
18	Workshop Expenses	11,800.00	1,51,830.00
19	Bank Charges	2,49,702.58	1,57,264.70
20	Office Expenses	9,26,463.36	2,88,400.21
21	Telephone Expenses	3,18,796.00	2,50,678.00
22	Audit Fees	1,25,000.00	1,15,168.00
23	Printing & Stationary Expenses	3,19,969.00	2,97,927.00
24	Hospitality Expenses	1,26,651.00	1,72,192.00
25	Insurance Charges	96,057.00	92,844.00
26	Manpower Expenses	69,00,045.00	10,07,018.00
27	LOGO Expenses	7,08,000.00	-
28	Advertisement Expenses	1,39,494.00	-
29	Annual Report Translation Fee	55,000.00	-
30	BSNL Lease Rent	8,90,705.00	-
31	Constitution Day Celeberation Expenses	82,653.00	-
32	Dispensary Expenses	74,802.00	-
33	Soil Investigation Expenses	2,23,800.00	-
34	Freight & Cartage	19,200.00	-
35	Registration Expenses	65,003.00	-
36	Licence Fee Renewal (ILMT)	80,012.00	-
37	Consultancy/IISF Expo/ILMT Hiring / Training	-	45,63,358.00
	TOTAL	6,10,68,030.87	6,20,01,887.09

*As per separate list attached.

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

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)
MANORA PEAK, NAINITAL
SCHEDULES FORMING PART OF INCOME & EXPENDITURE FOR THE YEAR ENDED 31st March 2021

	SCHEDULE 23 - EXPENDITURE ON PROJECTS		(Amount in Rupees)
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021 (Debit)	Previous Year For the year ended 31st March 2020 (Debit)
1	Project Exp - ISRO - GBP (ABLN & C)	6,76,533.00	29,29,589.00
2	Project Exp - DST/IMRCD/BRICKS/PILOTCALL/2017G	7,60,278.50	8,23,714.00
3	Project Exp - DST/INSPIRE FACULTY-BATCH-13/2017	29,93,863.50	9,51,969.00
4	Project Exp - DST/INSPIRE/FELLOWSHIP/2019	2,48,000.00	1,68,967.00
5	Project Exp - DST / INT / POL / P-19 / 2016	43,591.00	77,861.95
6	Project Exp - DST / INT / THAI / P-15	48,235.00	49,794.50
7	Project Exp - EMR / 2016 / 001723	3,48,902.00	3,66,000.00
8	Project Exp - ISRO ENVIRONMENTAL - ATCTM	56,01,289.50	12,07,879.50
9	Project Exp - ISRO - GBP (ARFI)	6,50,166.00	5,50,321.00
10	Project Exp - UCOST - R & D - PM	1,73,487.25	4,11,391.30
11	Project Exp - INT / AUS / BMWF / P-14 / 2018	8,106.00	1,28,604.50
12	Project Exp - DST / INT / BELG / P-09 / 2017	1,41,265.50	-
13	Project Exp - DST / INT / BELG / P-02 / 2014	7,472.00	-
14	Project Exp - S. T. RADAR	34,75,000.00	-
15	Project Exp - DST / INSPIRE	-	5,09,671.00
16	Project Exp - ILTP Project	-	27,003.00
17	Project Exp - Indo Autria (Dr A.K.Srivastva)	-	36,422.00
18	Project Exp - INT / RUS / RFBR / P-271	-	20,883.00
19	Project Exp - PDF / 2016 / 003032	-	2,12,500.00
20	Project Exp - PDF / 2016 / 003848	-	2,15,657.75
	TOTAL	1,51,76,189.25	86,88,228.50

	SCHEDULE 24 - INTEREST EXPENDITURES		(Amount in Rupees)
S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021 (Debit)	Previous Year For the year ended 31st March 2020 (Debit)
1	On Fixed Loans	-	-
2	On Other Loans (including Bank Charges)	-	-
3	Others (specify)		
	-Interest returned to DST (2019-2020)	37,96,504.00	22,56,462.00
	-Interest payable to DST (2020-2021)	60,41,409.00	-
	-Interest accrued on GPF A/C	30,91,061.00	28,90,006.00
	- Interest - TDS	6,808.00	-
	TOTAL	1,29,35,782.00	51,46,468.00

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

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

ANNEXURE OF SCH 8 (2): STATEMENT OF SUNDRY CREDITORS AS ON 31.03.2021

S. NO.	PARTICULARS	Current Year For the year ended 31st March 2021	Previous Year For the year ended 31st March 2020
		Credit	Credit
1	PRINCETONE INSTRUMENTS	-	13,90,293.00
2	KUMAUN AUTO SALES	-	2,56,923.00
3	SHRI BALAJI CRANE SERVICES	-	35,400.00
4	DEVKI NANDAN	-	4,813.00
	Total	-	16,87,429.00

Annexed to **Schedule 8 (2)** of the Balance Sheet of even date attached.

STATEMENT OF TDS PAYABLE AS ON 31.03.2021
(ANNEXURE OF SCH 8 (6)(d) - OTHER CURRENT LIABILITIES)

S. NO.	PARTICULARS	Current Year For the year ended 31st March 2021	Previous Year For the year ended 31st March 2020
		Credit	Credit
1	TDS - Consultants (March 2021)	1,69,873.00	70,889.00
2	TDS - Contractors (March 2021)	66,714.00	52,772.00
3	TDS - Inspire Project (March 2021)	43,746.00	-
4	TDS - Salary & Pension (March 2021)	91,427.00	71,400.00
	Total	3,71,760.00	1,95,061.00

Annexed to **Schedule 8 (6)(d)** of the Balance Sheet of even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

PLACE : HALDWANI
DATED : August 31, 2021

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

ANNEXURE OF SCH 8 (5)(c):
STATEMENT OF NPS (EMPLOYEE'S CONTRIBUTION) PAYABLE AS ON 31.03.2021

S. NO.	PARTICULARS	Current Year	Previous Year
		For the year ended 31st March 2021	For the year ended 31st March 2020
		Credit	Credit
1	Balance as per Last Account (31.03.2020)	23,853.00	23,853.00
2	NPS-Gourav Meena (Employee Share) Payable	5708.00	-
3	NPS-Suvendu Rakshit (Employee Share) Payable	22996.00	-
4	NPS-Vaibhav Pant (Employee Share) Payable	15842.00	-
5	NPS-Vaidehi (Employee Share) Payable	18397.00	-
6	NPS-Virendra Yadav (Employee Share) Payable	18424.00	-
	Total	1,05,220.00	23,853.00

Annexed to Schedule 8 (5)(c) of the Balance Sheet of even date attached.

ANNEXURE OF SCH 8 (5)(d):
STATEMENT OF NPS (EMPLOYER'S CONTRIBUTION) PAYABLE AS ON 31.03.2021

S. NO.	PARTICULARS	Current Year	Previous Year
		For the year ended 31st March 2021	For the year ended 31st March 2020
		Credit	Credit
1	NPS-Gourav Meena (Employee Share) Payable	5708.00	-
2	NPS-Suvendu Rakshit (Employee Share) Payable	22996.00	-
3	NPS-Vaibhav Pant (Employee Share) Payable	15842.00	-
4	NPS-Vaidehi (Employee Share) Payable	18397.00	-
5	NPS-Virendra Yadav (Employee Share) Payable	18424.00	-
	Total	81,367.00	-

Annexed to Schedule 8 (5)(d) of the Balance Sheet of even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

ANNEXURE OF SCH 8 (6)(a): STATEMENT OF EARNEST MONEY DEPOSITS AS ON 31.03.2021

S. NO.	PARTICULARS	Current Year	Previous Year
		For the year ended 31st March 2021	For the year ended 31st March 2020
		Credit	Credit
1	EMD - AMSH Product	35,000.00	-
2	EMD - Bigprint Sports	16,000.00	-
3	EMD - Connecting Solution	21,600.00	-
4	EMD - C-Tech Enterprises	85,000.00	-
5	EMD - Kishu Electrotech (OPC) Pvt Ltd	44,900.00	-
6	EMD - Macquarie University	40,00,000.00	-
7	EMD - Madan Singh Bisht	35,000.00	35,000.00
8	EMD - Microcomm India Ltd New Delhi	18,000.00	18,000.00
9	EMD - Micro Epsilon India Pvt. Ltd	40,500.00	-
10	EMD - PCI Pest Control Pvt Ltd GEO	22,500.00	22,500.00
11	EMD - Scube Scientific	22,500.00	-
12	EMD - Valve	30,000.00	-
13	EMD - Biva Securities Deharadun	-	50,000.00
14	EMD - Goldu Enterprises Nainital	-	48,000.00
15	EMD - National Analytical Corporation Mumbai	-	12,000.00
16	EMD - PPS Pvt Ltd Pune	-	20,000.00
17	EMD - SABO Systems Pvt Ltd Lucknow	-	35,000.00
18	EMD - Shreedhar Traders Kathgodam	-	12,615.00
19	EMD - Surya Gen Power	-	70,000.00
	Total	43,71,000.00	3,23,115.00

Annexed to Schedule 8 (6)(a) of the Balance Sheet of even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

PLACE : HALDWANI
DATED : August 31, 2021

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

ANNEXURE OF SCH 8 (6)(b): STATEMENT OF PERFORMANCE SECURITY DEPOSITS AS ON 31.03.2021

S. NO.	PARTICULARS	Current Year For the year ended 31st March 2021	Previous Year For the year ended 31st March 2020
		Credit	Credit
1	PSD - Anritsu India Pvt Ltd	30,000.00	30,000.00
2	PSD - Convergent Technologies	11,570.00	-
3	PSD - ESRI India Technologies Ltd (PSD)	52,442.00	40,130.00
4	PSD - LWI Electronics INC	5,398.00	-
5	PSD - Mudra Electronics Ltd, Deharadun	28,925.00	28,925.00
6	PSD - PCI Pest Controls Pvt Ltd	30,000.00	30,000.00
7	PSD - Servokon Systems Ltd	1,17,373.00	1,17,373.00
8	PSD - Shreya Traders Rampur	7,840.00	49,971.00
9	PSD - Simplex Control Equipments Deharadun	3,33,800.00	3,33,800.00
10	PSD - SS Enterprises	51,778.00	-
11	PSD - Sun Sine Power Quest	3,421.00	-
12	PSD - Sun Sine Power Quest Pvt Ltd	7,798.00	-
13	PSD - Surya Gen Power	1,22,500.00	-
14	PSD - SV Electronics	13,039.00	-
15	PSD - TENET Technetronics	16,000.00	-
16	PSD - Unified Electrotech Pvt Ltd	15,672.00	-
17	PSD - Yash Enterprises	19,388.00	-
18	PSD - Advance International	-	27,366.00
19	PSD - Caterpillar Electric Pvt Ltd	-	1,12,009.00
20	PSD - CGM Computers Haldwani	-	4,094.00
21	PSD - Classic Automation Rudrapur	-	891.00
22	PSD - Gopal Sound Services Nainital	-	27,542.00
23	PSD - Hartech & Controls Bareilly	-	18,502.00
24	PSD - IEE Lifts Mohali	-	1,76,500.00
25	PSD - Kumaun Auto Sales Kashipur	-	2,92,648.00
26	PSD - Netsquare Automation Pvt Ltd	-	19,533.00
27	PSD - Sandvic Component Ghaziabad	-	4,523.00
28	PSD - Spin AQM Technologies (India) Pvt Ltd	-	23,000.00
	Total	8,66,944.00	13,36,807.00

Annexed to **Schedule 8 (6)(b)** of the Balance Sheet of even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

ANNEXURE OF SCH 8 (6)(g): STATEMENT OF OUTSTANDING EXPENSES AS ON 31.03.2021

S. NO.	PARTICULARS	Current Year	Previous Year
		For the year ended 31st March 2021	For the year ended 31st March 2020
		Credit	Credit
1	Interest payable to DST (2020-21)	60,41,409.00	-
2	Internet Connection Charges	2,58,420.00	-
3	Legal Expenses	75,000.00	-
4	Audit Fee (2020-21)	62,500.00	-
5	AMC - UPS (Novatour)	70,800.00	-
6	AMC - UPS (Rellow Power)	99,784.00	-
7	AMC - Computer (Primus Security)	93,810.00	-
8	Pest Control Expenses	41,394.00	-
9	Contract Emplyee Salary	25,272.00	-
10	Telephone Expenses (Devasthal)	25,000.00	-
11	Telephone Expenses	10,802.00	-
12	Electricity Expenses (Transit Camp)	5,704.00	-
13	NSDL (NPS) Maintenance & Training Charges	5,030.00	-
	Total	68,14,925.00	-

Annexed to Schedule 8 (6)(g) of the Balance Sheet of even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

ANNEXURE OF SCH 12(A)(4): LIST OF BANK ACCOUNTS AS ON 31.03.2021

S. NO.	PARTICULARS	Current Year For the year ended 31st March 2021	Previous Year For the year ended 31st March 2020
		Debit	Debit
1	Director's (SBI) Bank A/C 10860840253	14,27,01,221.55	15,50,29,872.06
2	GPF (SBI) A/C 10860840300	1,18,53,494.30	98,15,230.30
3	SBI (Canteen) Bank A/C 32320085086	1,63,062.99	-
4	SBI (Staff Welfare Fund) Bank A/C - 39589660093	35,570.50	-
5	LC No - 2016-04 (SBI) A/C 35822432563	-	18,33,052.00
6	Pension Fund A/Cs:		
	Pension Fund (SBI) A/C - 10860840311	6,46,30,952.70	65,160.70
	Pension Fund (UBI) A/C - 534702010000535	7,14,565.02	6,93,046.02
	Total (6)	6,53,45,517.72	7,58,206.72
7	Project Bank A/Cs		
	SBI (ISRO-GBP-ARFI) Bank A/C 30192927780	11,47,539.50	17,57,208.50
	SBI (BINA II Project) Bank A/C 39216610583	7,05,368.50	-
	SBI (ISRO ATCTM Project) Bank A/C 30310168038	49,75,224.50	1,03,57,765.00
	SBI (ISRO-GBP-ABLN & C) Bank A/C 30318931302	1,83,095.50	5,52,834.50
	SBI (LC No: 2016-04) Bank A/C 35822432563	19,28,329.00	-
	SBI (ST RADAR Project) Bank A/C 30357703902	20,96,728.00	9,66,731.00
	SBI (DST - ILTP Project) Bank A/C 31286509555	2,65,496.50	2,58,396.50
	SBI (EMR-2016-1723 Project) Bank A/C 37039717963	2,01,149.50	5,39,394.50
	SBI (INT / POL Project) Bank A/C 37039721038	2,64,048.55	3,00,377.55
	SBI Project Bank A/C 372665312845	4,24,566.50	4,13,214.50
	SBI (BRICS Project) Bank A/C 37598108567	6,64,034.00	32,954.50
	SBI (INSPIRE Faculty Project) Bank A/C 38098705686	11,74,708.50	2,96,487.00
	SBI (BMWF Project) Bank A/C 38532163287	3,12,886.50	3,12,501.50
	SBI (Thai Project) Bank A/C 38832273131	1,62,270.50	2,05,640.50
	SBI (INSPIRE Fellowship) Bank A/C 39092267684	11,189.00	2,54,167.00
	UCO (UCOST Project) BANK A/C 28720110011577	25,122.45	1,95,397.70
	SBI (GVAX Project) Bank A/C - 31745765543	542.00	-
	SBI PROJECT A/C 36065850402	-	7,175.54
	Total (7)	1,45,42,299.00	1,64,50,245.79
	Grand Total (1+2+3+4+5+6)	23,46,41,166.06	18,38,86,606.87

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

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES,
Nainital

(REGISTRAR) (DIRECTOR)

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

ANNEXURE OF SCH 12(B)(1)(a): STATEMENT OF LOANS TO STAFF AS ON 31.03.2021

S. NO.	PARTICULARS	Current Year For the year ended 31st March 2021	Previous Year For the year ended 31st March 2020
		Debit	Debit
1	Car Advance - Staff		
	Car Advance (B.Krishna Reddy)	39,150.00	55,350.00
	Car Advance (Narender Singh)	43,200.00	64,800.00
	Car Advance (Sanjit Sahu)	72,000.00	96,000.00
	Car Advance (Saurabh)	33,600.00	53,760.00
	Car Advance (U.C.Dumka)	54,000.00	90,000.00
	Total (1)	2,41,950.00	3,59,910.00
2	Computer Advance - Staff		
	Computer Advance (A.K.Sharma)	27,000.00	39,000.00
	Computer Advance (D.S.Negi)	21,000.00	33,000.00
	Computer Advance (Hemant Kumar)	29,000.00	41,000.00
	Computer Advance (Himanshu)	27,000.00	39,000.00
	Computer Advance (Manjay Yadav)	19,000.00	31,000.00
	Computer Advance (Naveen C. Arya)	31,000.00	43,000.00
	Computer Advance (R.D.Bhatt)	19,000.00	31,000.00
	Computer Advance (R.K.Yadav)	31,000.00	50,000.00
	Computer Advance (Arjun Singh)	44,000.00	-
	Computer Advance (Ashok)	34,000.00	-
	Computer Advance (S C Arya)	44,000.00	-
	Computer Advance (B B Bhatt)	47,000.00	-
	Computer Advance (S.K.Singh)	19,000.00	31,000.00
	Computer Advance (Mahesh Pandey)	-	4,500.00
	Total (2)	3,92,000.00	3,42,500.00
3	HBA Advance - Staff		
	HBA Advance (Bharat Singh)	4,92,000.00	5,70,000.00
	HBA Advance (Chandra Prakash)	59,015.00	1,23,395.00
	HBA Advance (Dr. Brijesh Kumar)	4,32,000.00	5,04,000.00
	HBA Advance (Dr. Narendra Singh)	5,65,000.00	6,25,000.00
	HBA Advance (Dr. Saurabh)	9,04,000.00	9,76,000.00
	HBA Advance (M.K.Naza)	2,58,750.00	3,03,750.00
	HBA Advance (Samaresh Bhattacharjee)	4,74,000.00	5,46,000.00
	Total (3)	31,84,765.00	36,48,145.00
4	M-Cycle Advance - Staff		
	M-Cycle Advance (S.C.Arya)	-	5,500.00
	M-Cycle Advance (V.K.Singh)	9,500.00	15,500.00
	Total (4)	9,500.00	21,000.00
	Grand Total (1+2+3+4)	38,28,215.00	43,71,555.00

Annexed to Sch 12(B)(1)(a) of the Balance Sheet of even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

ANNEXURE OF SCH 12(B)(2)(b): STATEMENT OF PREPAID EXPENSES AS ON 31.03.2021

S. NO.	PARTICULARS	Current Year	Previous Year
		For the year ended 31st March 2021	For the year ended 31st March 2020
		Credit	Credit
1	ASTRAD Annual License Fee	540750.00	-
2	Electricity Expenses (Manora Peak)	1558510.00	-
3	Repair & Maintenance - Internet	389400.00	-
4	Water Expenses	1000000.00	-
5	BSNL Lease Rent	573480.00	-
6	BSNL Lease Rent	212400.00	-
7	Vehicle Insurance	39223.00	-
	Total	43,13,763.00	-

Annexed to Schedule 12(B)(2)(b) of the Balance Sheet of even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

ANNEXURE OF SCH 12(B)(2)(c): STATEMENT OF ADVANCES & OTHER RECEIVABLES AS ON 31.03.20201

S. NO.	PARTICULARS	Current Year For the year ended 31st March 2021	Previous Year For the year ended 31st March 2020
		Debit	Debit
1	LTC Advances to Employees:		
	LTC Advance (V K Singh)	9,200.00	-
	LTC Advance (C Arjuna Reddy)	63.00	20,000.00
	LTC Advance (Ashish Kumar)	37,000.00	-
	LTC Advance (Sanjit Sahu)	40,500.00	-
	LTC Advance (Kanhaiya Prasad)	-	2,600.00
	LTC Advance (Pradeep Chakraborty)	-	23,500.00
	Total (1)	86,763.00	46,100.00
2	TA Advances to Employees		
	TA Advance (Avrajit Bandyopadhyay)	1,365.00	-
	TA Advance (Pankaj Kushwaha)	1,000.00	-
	TA Advance (Sindhu Pandey)	385.00	
	TA Advance (2019-2020)	-	1,25,800.00
	Total (2)	2,750.00	1,25,800.00
3	Sundry Advances to Employees		
	Advance (Aditya Jaiswal)	3,600.00	-
	Advance (Alok Chandra Gupta)	10,000.00	-
	Advance (Alaxender Panchal)	9,900.00	-
	Advance (M. Naza)	14,500.00	-
	Advance (Ankur Ghosh)	12,700.00	-
	Advance(Anjasha Gangopadhyay)	9,000.00	-
	Advance (Dr Wahab Uddin)	9,000.00	-
	Advance (Pradeep Chakraborty)	12,021.00	-
	Advance (Ravindra Kumar Yadav)	3,500.00	-
	Advance (D. S. Negi)	12,000.00	-
	Advances (2019-2020)	-	14,41,373.00
	Total (3)	96,221.00	14,41,373.00
4	Seurities & Deposits:		
	Security for Gas Connection	8,500.00	8,500.00
	Security with BSNL	5,000.00	5,000.00
	Security with Electricity	6,75,617.00	6,75,617.00
	Security with Telephone	10,000.00	10,000.00
	Total (4)	6,99,117.00	6,99,117.00
5	TDS Receivables:		
	TDS - GPF FDR 2019-2020	1,75,244.00	1,75,244.00
	TDS - GPF FDR 2020-2021	1,04,956.00	-
	TDS - Pension Fund (MOD) - 2020-2021	2,19,926.00	-
	TDS - STRADAR FDR 2019-2020	43,500.00	43,500.00
	TDS - STRADAR FDR 2020-2021	19,025.00	-
	TDS Receivable (Till 2018-19)	5,56,541.00	12,94,572.00
	Total (5)	11,19,192.00	15,13,316.00

Continued to page -2-

MUKESH GOEL & CO. HALDWANI M.9[illegible]406674 Chartered Accountants

S. NO.	PARTICULARS	Current Year For the year ended 31st March 2021	Previous Year For the year ended 31st March 2020
		Debit	Debit
6	Deposit Against Income Tax Demand	68,00,000.00	68,00,000.00
7	Other Advances:	-	1,63,14,715.56
8	ISRO-Project Cost Receivable	-	40,25,982.00
9	Advance to Natioanal Institute of Design for LOGO	-	3,54,000.00
	Total (6+7+8+9)	68,00,000.00	2,74,94,697.56
10	Festival Advances to Employees:		
	Festival Advance - Abhishek Sharma	10,000.00	-
	Festival Advance - Ashok	9,000.00	-
	Festival Advance - B. B. Bhatt	9,000.00	-
	Festival Advance - Gourav Meena	9,000.00	-
	Festival Advance - Hansa Karki	9,000.00	-
	Festival Advance - Hemant Kumar	9,000.00	-
	Festival Advance - Himanshu Vidhyarthi	9,000.00	-
	Festival Advance - Lalit Mohan Dalakoti	9,000.00	-
	Festival Advance - Mahesh Chandra Pandey	9,000.00	-
	Festival Advance - Manjay Yadav	9,000.00	-
	Festival Advance - Manoj Kumar Mahto	10,000.00	-
	Festival Advance - Praveen Solanki	9,000.00	-
	Festival Advance - Rajdeep Singh	9,000.00	-
	Festival Advance - Ram Dayal Bhatt	9,000.00	-
	Festival Advance - Ravinder Kumar	9,000.00	-
	Festival Advance - Ravinder Kumar Yadav	9,000.00	-
	Festival Advance - Sanjay Kumar Singh	9,000.00	-
	Festival Advance - Shashi Bhushan Pandey	9,000.00	-
	Festival Advance - Snehlata	10,000.00	-
	Festival Advance - Tarun Bangia	9,000.00	-
	Festival Advance - Virendera Kumar Singh	9,000.00	-
	Total (10)	1,92,000.00	-
	Grand Total (1+2+3+4+5+6+7+8+9+10)	89,96,043.00	3,13,20,403.56

Annexed to Sch 12(B)(2)(c) of the Balance Sheet of even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

ANNEXURE OF SCH-21: LIST OF PAY & ALLOWANCES FOR THE YEAR ENDED 31.03.2021

S. NO.	PARTICULARS	Current Year For the year ended 31st March 2021	Previous Year For the year ended 31st March 2020
		DEBIT	DEBIT
1	SALARIES & WAGES:		
	Pay / Salaries - Employees	7,16,98,527.00	5,96,87,432.00
	Pension	1,93,47,562.00	1,96,99,202.00
	MACP & Promotion Arrear	1,09,70,925.00	76,276.00
	Honorarium	1,97,632.00	2,42,250.00
	Total (1)	10,22,14,646.00	7,97,05,160.00
2	ALLOWANCES & BONUS:		
	a) Dearness Allowance		
	Dearness Allowance	1,21,91,596.00	1,26,10,659.00
	DA on TA	4,46,693.00	4,19,418.00
	b) House Rent Allowance	24,94,587.00	20,82,359.00
	c) Transport Allowance	26,27,550.00	21,16,500.00
	d) Cash Handling Allowance	8,400.00	7,700.00
	e) Hill Compensation & Washing Allowance	-	19,280.00
	Total (2)	1,77,68,826.00	1,72,55,916.00
3	Employer Contribution - NPS	65,18,669.00	50,34,904.00
	Total (3)	65,18,669.00	50,34,904.00
4	OTHERS:		
	a) Medical Expenses		
	Medical Expenses	-	2,50,556.00
	Medical Expenses Brij Lal Hospital	7,94,222.00	12,57,657.00
	Medical Expenses (Krishna Hospital)	2,46,480.00	4,06,657.00
	Medical Expenses (Sai Hospital)	1,05,908.00	1,79,456.00
	Medical Reimbursement	20,18,314.00	8,64,096.00
	Total [4 (a)]	31,64,924.00	29,58,422.00
	b) Fellowship		
	Fellowship	2,02,02,599.00	1,21,39,550.00
	Fellowship Arrear	1,46,065.00	17,95,254.00
	CSIP Stipend	19,999.00	-
	Total [4 (b)]	2,03,68,663.00	1,39,34,804.00
	c) Leave Encashment	7,40,493.00	4,01,683.00
	d) Leave Travel Concession	83,879.00	11,14,977.00
	e) Special Cash Package Expenses	14,05,487.00	-
	e) Reimbursement of Tution Fee	14,38,195.00	22,24,295.00
	Total (4)	2,72,01,641.00	2,06,34,181.00
	Total (1+2+3+4)	15,37,03,782.00	12,26,30,161.00

Annexed to **Schedule 21** of Income & Expenditure of even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

ANNEXURE OF SCH 22 (1):
LIST OF REPAIR & MAINTENANCE (MINOR WORKS) FOR THE YEAR ENDED 31.03.2021

S. NO.	PARTICULARS	Current Year For the year ended 31st March 2021	Previous Year For the year ended 31st March 2020
		DEBIT	DEBIT
1	Repair & Maintance - Telescope/Instruments Service	13,32,193.00	1,85,552.00
2	Repair & Maintenance - Vehicle	2,28,777.00	2,45,184.00
3	Repair & Maintenance - Others	2,11,743.00	1,65,953.00
4	Repair & Maintenance - 3.6M DOT	23,157.00	3,07,175.00
5	Repair & Maintenance - Building	18,88,597.00	10,76,748.00
6	Repair & Maintenance - Computer	12,980.00	89,876.00
7	Repair & Maintenance - Electric Items	95,841.00	53,100.00
8	Repair & Maintenance - Fire Extinguisher	54,170.00	1,30,007.00
9	Repair & Maintance - Computer Accessories	5,271.00	-
10	Repair & Maintance - Generator	64,054.00	-
11	Repair & Maintenance - Internet	-	8,850.00
12	Repair & Maintenance - Fire Alarm	-	47,355.00
	Total	39,16,783.00	23,09,800.00

Annexed to Sch 22 (1) of the Statement of Income & Expenditure of even date attached.

ANNEXURE OF SCH 22 (2): LIST OF CONSUMABLE EXPENSES FOR THE YEAR ENDED 31.03.2021

S. NO.	PARTICULARS	Current Year For the year ended 31st March 2021	Previous Year For the year ended 31st March 2020
		DEBIT	DEBIT
1	Consumables (3.6mt Telescope)	51,286.00	1,22,880.00
2	Consumables (Machinical)	2,31,798.00	40,380.00
3	Consumables (Electrical)	1,53,697.00	4,99,885.00
4	Consumables (Computer)	56,502.00	2,31,995.00
5	Consumables (Others)	22,14,184.00	5,33,462.00
6	Observational Facilities (Consumable)	31,352.00	4,02,693.00
7	Observational Facilities (LN2 Gas)	4,78,954.00	1,52,266.00
8	Consumables (Workshop)	29,244.50	36,917.00
9	Consumables (4.2 ILMT Project)	-	4,50,394.00
10	Consumables (Aluminising / Anodising)	-	13,998.79
11	Consumables (Materials)	-	7,96,758.00
12	Consumables (OPTICS)	-	29,647.00
	Total	32,47,017.50	33,11,275.79

Annexed to Sch 22 (2) of the Statement of Income & Expenditureof even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

ANNEXURE OF SCH-22 (3): LIST OF OTHER ADMINISTRATIVE EXPENSE FOR THE YEAR ENDED 31.03.2021

S. NO.	PARTICULARS	Current Year For the year ended 31st March 2021	Previous Year For the year ended 31st March 2020
		DEBIT	DEBIT
1	Canteen Expenses	49,70,854.00	22,12,389.00
2	Water Expenses	9,42,914.00	8,47,057.00
3	Pest Control Expenses	2,62,524.00	1,86,273.00
4	Internet Charges	6,19,233.00	22,99,894.00
5	Wages	1,74,237.00	1,39,250.00
6	Return Filing Fees - GST/TDS	1,13,493.00	80,775.00
7	NPS Service Charges	9,841.00	7,144.00
8	Gardening Expenses	23,695.00	63,972.00
9	Certification Fee	10,000.00	35,400.00
10	Guest House Expenses	10,277.00	-
11	Labour Charges	4,200.00	-
12	Laundry Expenses	3,000.00	-
13	Ph. D. Registration Expenses	5,48,802.00	-
14	Food Bill Expenses (ARIES Canteen)	-	3,00,715.00
15	Postage Expenses	-	20,000.00
16	LC Issuance Charges	-	24,406.00
17	Antivirus Expenses	-	51,989.00
	Total	76,93,070.00	62,69,264.00

Annexed to Schedule 22 (3) of the Statement of Income & Expenditure of even date attached.

ANNEXURE OF SCH 22 (4): LIST OF MEETING EXPENSES FOR THE YEAR ENDED 31.03.2021

S. NO.	PARTICULARS	Current Year For the year ended 31st March 2021	Previous Year For the year ended 31st March 2020
		DEBIT	DEBIT
1	ATSOA 2020 Meeting Expenses	6,974.00	-
2	Hindi Program Expenses	46,000.00	89,300.00
3	JEST 2020 Meeting Expenses	50,000.00	25,000.00
4	Public Outreach Programme	1,03,455.00	2,01,839.00
5	Scientific Meeting Expenses	2,213.00	2,40,166.00
6	ASI-2020 Meeting Expenses	-	2,00,000.00
7	Asia Solar Physics Meeting Expenses	-	2,00,000.00
8	ESC Meeting Expenses	-	50,983.00
9	G.C. Meeting Expenses	-	1,95,625.00
	Total	2,08,642.00	12,02,913.00

Annexed to Schedule 22 (4) of the Statement of Income & Expenditure of even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719405671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

ANNEXURE OF SCH 22 (6): LIST OF PRIOR PERIOD EXPENSES FOR THE YEAR ENDED 31.03.2021

S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021 (Debit)	Previous Year For the year ended 31st March 2020 (Debit)
1	AMC Expenses	3,17,797.00	-
2	Pest Control Expenses	62,091.00	-
3	Repair & Maintenance - Fire Extinguisher	75,837.00	-
4	NSDL (NPS) Maint. & Transaction Charges	2,296.00	-
5	Telephone Expenses	23,165.00	-
6	Electricity Expenses	4,86,126.00	-
7	NPS Employer's Contribution - R.Kumar (till 2018-19)	-	2,81,823.00
8	NPS Employee Contribution - R.Kumar (Arrear 2018-19)	-	19,082.00
9	Project (BRNS) Bank A/C	-	1,79,222.00
10	Project (ISRO) Bank A/C	-	23,600.00
11	Licence Fee-CSNOF-05 (2018-19)	-	7,54,843.00
12	Cleaning Expenses (2018-19)	-	(1,36,696.00)
13	LC A/C No 2016-04	-	(3,12,348.00)
14	Group Inssurance	-	(12,099.00)
15	TDS - Salary	-	(16,373.00)
16	TDS - Contractor	-	(2,053.28)
17	Project (PDF/2016/003848) Bank A/C	-	(42,984.00)
18	Project (Poland/P-19) Bank A/C	-	(9,207.50)
19	Project (BRNS) Bank A/C	-	(1,988.00)
20	Project (U-COST) Bank A/C	-	(4,03,375.00)
	TOTAL	9,67,312.00	3,21,446.22

Annexed to Sch 22 (6) of the Statement of Income & Expenditureof even date attached.

ANNEXURE OF SCH 22 (5): LIST OF AMC EXPENSES FOR THE YEAR ENDED 31.03.2021

S.NO	PARTICUALRS	Current Year For the year ended 31st March 2021 (Debit)	Previous Year For the year ended 31st March 2020 (Debit)
1	AMC Expenses - CNC Machine (Bharat Friz)	1,50,000.00	1,96,200.00
2	AMC Expenses - Computer (Primus Systems)	2,81,430.00	5,36,598.17
3	AMC Expenses - Cranes (IMT)	1,61,902.00	-
4	AMC Expenses - UPS (Agilent)	58,803.00	-
5	AMC Expenses - UPS (Novataur)	1,06,200.00	2,34,968.00
6	AMC Expenses - UPS (Rellow Power)	3,99,136.00	
7	AMC Expenses - Electric Section	-	3,27,273.00
	TOTAL	11,57,471.00	12,95,039.17

Annexed to Sch 22 (5) of the Statement of Income & Expenditureof even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

STATEMENT OF RECEIPT AND PAYMENT FOR THE YEAR ENDED 31ST MARCH 2021

S. No	RECEIPTS	Current Year 2020-2021	Current Year 2020-2021	S. No	PAYMENTS	Current Year 2020-2021	Current Year 2020-2021
I	Opening Balances:			I	Capital Account		
	a) Bank Balances	18,38,86,606.87			Earmarked / Endowment Funds	2,30,02,637.00	2,30,02,637.00
	b) Cash-in-Hand	18,608.00	18,39,05,214.87				
II	Capital Account			II	Fixed Assets		
	Staff Welfare Fund	35,570.50			Furniture & Fixtures	18,69,784.00	
	Reserves & Surplus	3,96,881.49			Library Books & Journals	3,09,860.00	
	Corpus / Capital Fund	10,95,00,000.00			Vehicles	13,59,663.00	
	Endowment Funds	80,20,933.00	11,79,53,384.99		Buildings & Infrastructures	32,11,012.00	
					Capital Work-in-Progress	3,54,73,600.00	
III	Current Liabilities				Computers / Peripherals	80,25,247.00	
	Current Liabilities & Provisions	23,74,077.50	23,74,077.50		Plants Machineries & Equipments	3,59,76,345.00	
					Other Fixed Assets	7,08,021.00	
IV	Investments				Office Equipments	5,04,802.00	
	Investments - Others	45,54,800.00	45,54,800.00		Electric Installations	37,80,271.00	9,12,18,605.00
V	Current Assets			III	Current Assets		
	Car Advance (ARIES) A/C	1,17,960.00			Adv. Chandan Ram	2,500.00	
	Computer Advance (ARIES) A/C	1,42,500.00			Loans, Advances & Other Assets	25,40,097.00	25,42,597.00
	HBA (ARIES) A/c	1,21,380.00					
	OMCA Adv, (ARIES)	12,000.00		IV	Indirect Expenses		
	Loans, Advances & Other Asse	81,76,956.00	85,70,796.00		Establishment Expenses	15,34,84,253.00	
					Expenditure on Project Grants	1,51,76,189.25	
					Interest Expenses	38,03,312.00	
VI	Indirect Incomes				Other Administrative Expenses	6,41,51,718.87	23,66,15,473.12
	Grants / Subsidies	25,79,26,104.00					
	Interest Earned	49,24,943.46		V	Closing Balance		
	Other Incomes	78,11,157.36	27,06,62,204.82		Bank Balances (Schedule Banks	23,46,41,166.06	23,46,41,166.06
	Total		58,80,20,478.18		Total		58,80,20,478.18

As per our separate Audit Report of even date attached.

For MUKESH GOEL & CO.
CHARTERED ACCOUNTANTS

CA. MUKESH GOEL, FCA
PROPRIETOR
[FRN - 006150C]
[MRN - 073335]

MUKESH GOEL & CO. HALDWANI M.9719406671 Chartered Accountants

PLACE : HALDWANI
DATED : August 31, 2021

For and on behalf of ARIES, Nainital

(REGISTRAR) (DIRECTOR)

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

SCHEDULES FORMING PART OF THE ACCOUNTS FOR THE YEAR ENDED 31ST MARCH 2021

SCHEDULE 24 – SIGNIFICANT ACCOUNTING POLICIES:

1. ACCOUNTING CONVENTION:

The financial statements are prepared on the basis of historical cost convention, unless otherwise stated, and on the basis of **ACCRUAL method of accounting.**
Accounting policy related to the basis of preparation of accounts is changed in the current financial year 2020-21.

In the current financial year 2020-21 accounts *are prepared on "ACCRUAL" basis, while the accounts of the previous financial year 2019-20 were prepared on "CASH" basis.*

Further though accrual system of accounting is adopted during the FY 2020-21, transactions related to Salary and other establishment expenses as well as various recoveries out of the salary are recorded in the books of accounts on CASH basis.

2. INVENTORY VALUATION:

2.1 Stores and Spares (including machinery spares) are valued at cost.

2.2 Raw materials, semi-finished goods and finished goods are valued at lower of cost and net realizable value. The costs are based on weighted average cost. Cost of finished goods and semi-finished goods is determined by considering material, labour and related overheads.

3. INVESTEMNTS:

3.1 Investments classified as "long term investments" are carried at cost. Provision for decline, other than temporary, is made in carrying cost of such investments.

3.2 Investments classified as "Current" are carried at lower of cost and fair value. Provision for shortfall on the value of such investments is made for each investment considered individually and not on a global basis.

3.3 Cost includes acquisition expenses like brokerage, transfer stamps etc.

4. FIXED ASSETS:

4.1 Fixed assets are stated at cost of acquisition inclusive of inward freight, duties and taxes and incidental and direct expenses related to acquisition. In respect of projects involving constructions, related pre-operational expenses (including interest on loans for specific project prior to its completion), form part of the value of the assets capitalized.

4.2 Fixed assets received by way of non-monetary grants, (other than towards the Corpus Fund), are capitalized at values stated by corresponding credit to Capital Reserve.

5. DEPRECIATION:

5.1 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.

Continued to page -2-

5.2 In respect of additions to/deductions from fixed assets during the year, depreciation is considered as per income tax rules and not on pro-rata basis.

6. MISCELLANEOUS EXPENDITURE:

Deferred revenue expenditure is written off over a period of 5 years from the year it is incurred.

7. GOVERNMENT GRANTS/SUBSIDIES:

7.1 Government grants of the nature of contribution towards capital cost of setting up projects are treated as Capital Reserve.

7.2 Grants in respect of specific fixed assets acquired are shown as a deduction from the cost of the related fixed assets.

7.3 Government grants/subsidies are accounted on realization basis.

8. FOREIGN CURRENCY TRANSACTIONS:

8.1 Transactions denominated in foreign currency are accounted at the exchange rate prevailing at the date of the transaction.

8.2 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. RETIREMENT BENEFITS:

9.1 Liability towards gratuity payable on death/retirement of employees is paid based on actuarial valuation at the time of retirement.

9.2 Accumulated leave encashment benefit to the employees is computed on the assumption that employees are entitles to receive the benefit as at each year end and paid at the time of retirement.

10. LEASE:

Lease rentals are expensed with reference to lease terms.

PLACE: ARIES, NAINITAL
DATED: August 31, 2021

REGISTRAR
ARIES, NAINITAL

DIRECTOR
ARIES, NAINITAL

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

SCHEDULES FORMING PART OF THE ACCOUNTS FOR THE YEAR ENDED 31ST MARCH 2021

SCHEDULE 25 – CONTINGENT LIABILITES AND NOTES ON ACCOUNTS:

1. CONTINGENT LIABILITIES:

1.1 Claims against the Entity not acknowledged as debts — Rs. NIL (Previous year Rs. NIL)

1.2 In respect of: -

-Bank guarantees given by/on behalf of the Entity	Rs. NIL (Previous year Rs. NIL)
-Letters of Credit opened by Bank on behalf of the Entity	Rs. NIL (Previous year Rs. NIL)
-Bills discounted with Banks	Rs. NIL (Previous year Rs. NIL)

1.3 Disputed demands in respect of:

Income Tax	**Rs. 10,29,89,584.00 (Previous year - Same as above)**
Sales Tax/VAT/GST	Rs. NIL (Previous year Rs. NIL)
Municipal Taxes	Rs. NIL (Previous year Rs. NIL)

2. CAPITAL COMMITMENTS:

Estimated value of contracts remaining to be executed on capital account and not provided for (Net of advances) — Rs. NIL (Previous year Rs. NIL)

3. LEASE OBLIGATIONS:

Future obligations for rentals (finance lease arrangement)	Rs. NIL (Previous year Rs. NIL)
Arrangement for plant and machinery amount to	Rs. NIL (Previous year Rs. NIL)

4. CURRENT ASSETS, LOANS AND ADVANCES:

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 of the fact that the incomes of the entity are 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 2020-2021, no provision for Income tax has been considered necessary.

6. FOREIGN CURRENCY TRANSACTIONS:

	Current Year	Previous Year
6.1 Value of Imports Calculated on C.I.F Basis:		
-Purchase of finished Goods	Rs. NIL	Rs. NIL
-Raw Materials & Components (Including in transit)	Rs. NIL	Rs. NIL
-Capital Goods	**Rs. 53,16,318.94**	**Rs. 265,24,359.00**
-Stores, Spares and Consumables	**Rs. 40,21,046.28**	**Rs. 46,39,008.00**

Continued to page -2-

6.2 Expenditure in foreign currency:

a) Travel	**Rs. NIL**	**Rs. 11,07,197.00**
b) Remittances and Interest payments	Rs. NIL	Rs. NIL
c) Royalty	Rs. NIL	Rs. NIL
d) Know-how Expenses	Rs. NIL	Rs. NIL
e) Professional Consultancy Fee	**Rs. NIL**	**Rs. 105,23,897.00**

f) Other expenditure:

-Commission on Sales	Rs. NIL (Previous year Rs. NIL)
-Legal and Professional Expenses	Rs. NIL (Previous year Rs. NIL)
-Miscellaneous Expenses	Rs. NIL (Previous year Rs. NIL)

6.3 Earnings:

-Value of Exports on FOB basis — Rs. NIL (Previous year Rs. NIL)

7. PAYMENT TO AUDITORS:	**Current Year**	**Previous Year**
A. As statutory auditors	**Rs. 62,500.00**	**Rs. 62,500.00**
B. As advisor or in other capacity in respect of:		
i) Taxation matters	NIL	NIL
ii) Management Services	NIL	NIL
iii)Certification	**Rs. 10,000.00**	**Rs. 10,000.00**
C. Any other matter	NIL	NIL

8. Contingent Liabilities not provided for — NIL — 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 2021 and the Income and Expenditure Account for the year ended on that date.

PLACE: ARIES, NAINITAL
DATED: August 31, 2021

REGISTRAR
ARIES, NAINITAL

DIRECTOR
ARIES, NAINITAL

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

BALANCE SHEET OF ENDOWMENT FUND AS AT 31st MARCH 2021

LIABILITIES	Amount (in Rs.) 2020-2021	Amount (in Rs.) 2019-2020	ASSETS	Amount (in Rs.) 2020-2021	Amount (in Rs.) 2019-2020
CORPUS FUND:			**INVESTMENTS**		
A. GPF FUND:			FDR (SBI) - GPF	30,213,163.00	28,883,832.00
OPENING BALANCE	41,372,053.00	34,113,425.00	ACCRUED INTEREST (GPF - FDR)	246,064.00	275,690.00
ADD: EMPLOYEE'S CONTRIBUTION	7,225,900.00	6,642,675.00	FDR (UBI) - PENSION FUND	-	-
ADD: RECOVERY OF ADVANCES	177,500.00	269,150.00	ACCRUED INTEREST (PENSION)	869,222.00	-
ADD: INTEREST ACCRUED ON GPF	3,091,061.00	2,890,006.00			
LESS: ADVANCES	-	(499,100.00)			
LESS: WITHDRAWLS / RETIREMENT	(5,756,386.00)	(2,998,458.00)			
LESS: TRANSFERRED FROM/TO RESERVES	-	954,355.00			
TOTAL (A)	46,110,128.00	41,372,053.00			
B. PENSION FUND:			**CURRENT ASSETS :**		
OPENING BALANCE	44,236,446.56	44,236,446.56	BANK BALANCE - GPF (SBI) A/C 300	11,853,494.30	9,815,230.30
LESS: PENSION PAID	(16,757,926.00)	-	BANK BALANCE - PENSION (SBI) A/C 311	64,630,952.70	65,160.70
ADD: PENSION RECEIVED	70,120.00	-	BANK BALANCE - PENSION(UBI) A/C 535	714,565.02	693,046.02
TOTAL (B)	27,548,640.56	44,236,446.56			
TOTAL CORPUS FUIND (A + B)	73,658,768.56	85,608,499.56	**LOANS & ADVANCES:**		
			TDS - GPF RECEIVABLE (2019-20)	-	365,880.00
RESERVES & SURPLUS:			TDS - GPF RECEIVABLE (2020-21)	280,200.00	175,244.00
			TDS - PENSION RECEIVABLE (2020-21)	219,926.00	-
GPF RESERVES	4,879,418.56	4,879,418.56			
PENSION RESERVES	21,979,271.94	21,979,271.94	**ADVANCE - ARIES**		
			-FDR Maturity of Pension Fund	-	74,099,450.00
EXCESS OF SURPLUS / (DEFICIT)	(161,614.00)	1,874,692.96	- ARIES, NAINITAL (GPF)	7,101,478.26	5,837,024.26
CURRENT LIABILITIES:					
GPF PAYABLE	59,088.00	-			
TDS PAYABLE (PENSION)	-	31,650.00			
ARIES, NAINITAL (PENSION)	15,714,132.22	5,837,024.26			
TOTAL	116,129,065.28	120,210,557.28	**TOTAL**	116,129,065.28	120,210,557.28

For and on behalf of ARIES, Nainital

PLACE : HALDWANI
DATED : August 31, 2021

(REGISTRAR) (DIRECTOR)

ARYABHATTA RESEARCH INSTITUTE OF OBSERVATIONAL SCIENCES (ARIES)

MANORA PEAK, NAINITAL

STATEMENT OF INCOME & EXPENDITURE OF ENDOWMENT FUND FOR THE YEAR ENDING 31st MARCH 2021

EXPENDITURES	Amount (in Rs.) 2020-2021	Amount (in Rs.) 2019-2020	INCOMES	Amount (in Rs.) 2020-2021	Amount (in Rs.) 2019-2020
TO INTEREST ACCRUED (GPF)	3,091,061.00	2,890,006.00	BY FDR INTEREST (GPF)	1,399,403.00	1,752,415.00
			BY BANK INTEREST-SBI-300 (GPF)	337,423.00	239,020.00
TO BANK EXPENSES (PENSION)	-	8,100.00	BY FDR INTEREST (PENSION)	-	2,680,137.00
			BY BANK INTEREST-UBI-535 (PENSION)	21,194.00	96,222.00
			BY BANK INTEREST-SBI-311 (PENSION)	1,165,817.00	2,213.00
TO EXCESS OF INCOME /			BY OP. BANK BALANCE DIFF. (PENSION)	-	2,791.96
(EXPENDITURES)	(161,614.00)	1,874,692.96	BY INTEREST ON PENSION (UBI) 2019-20	5,610.00	-
TOTAL	2,929,447.00	4,772,798.96	TOTAL	2,929,447.00	4,772,798.96

For and on behalf of ARIES, Nainital

PLACE : HALDWANI
DATED : August 31, 2021

(REGISTRAR) (DIRECTOR)

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

BALANCE SHEET OF GPF FUND AS AT 31st MARCH 2021

(Amount in "Rupees")

S. NO	PARTICULARS	Current Year For the year ended 31st March 2021	Previous Year For the year ended 31st March 2020
	A. LIABILITIES:		
1	**GPF FUND:**		
	OPENING BALANCE	41,372,053.00	34,113,425.00
	ADD: EMPLOYEE'S CONTRIBUTION	7,225,900.00	6,642,675.00
	ADD: RECOVERY OF ADVANCES	177,500.00	269,150.00
	ADD: INTEREST ACCRUED ON GPF	3,091,061.00	2,890,006.00
	LESS: OPENING ADVANCES	-	(499,100.00)
	LESS: GPF WITHFRAWLS & RETIREMENT PAYMENTS	(5,756,386.00)	(2,998,458.00)
	LESS: TRANSFERRED FROM RESERVES (OP. DIFF.)	-	954,355.00
	TOTAL (1)	46,110,128.00	41,372,053.00
2	**RESERVES AND SURPLUS:**		
	OPENING BALANCE	4,879,418.56	-
	TRANSFERRED FROM GPF FUND (OP.DIFF)	-	4,879,418.56
	TOTAL (2)	4,879,418.56	4,879,418.56
3	**CURRENT LIABILITIES:**		
	GPF PAYABLE	59,088.00	-
	ARIES, NAINITAL [SURPLUS / (DEFICIT)]	(1,354,235.00)	(898,571.00)
	TOTAL (3)	(1,295,147.00)	(898,571.00)
	TOTAL LIABILITIES (A) (1 + 2 + 3)	49,694,399.56	45,352,900.56
	B. ASSETS:		
4	FDR IN SBI NAINITAL	30,213,163.00	28,883,832.00
7	BANK BALANCE (SBI) A/C 300	11,853,494.30	9,815,230.30
8	ACCRUED INTEREST	246,064.00	275,690.00
9	TDS - GPF RECEIVABLE (Opening)	-	365,880.00
10	TDS - GPF RECEIVABLE	280,200.00	175,244.00
11	ARIES, NAINITAL (BALANCING FIGURE)	7,101,478.26	5,837,024.26
	TOTAL ASSETS (B)	49,694,399.56	45,352,900.56

For and on behalf of ARIES, Nainital

PLACE : HALDWANI
DATED : August 31, 2021

(REGISTRAR) (DIRECTOR)

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

STATEMENT OF INCOME AND EXPENDITURE OF GPF FUND FOR THE YEAR ENDED 31st MARCH 2021

(Amount in "Rupees")

S. NO	PARTICULARS	Current Year For the year ended 31st March 2021	Previous Year For the year ended 31st March 2020
	(A) INCOMES:		
1	INTEREST ON FDR INVESTMENTS	1,399,403.00	1,752,415.00
2	INTEREST ON BANK (SBI) A/C 300	337,423.00	239,020.00
	TOTAL (A)	1,736,826.00	1,991,435.00
	(B) EXPENDITURES:		
3	INTEREST ACCRUED ON GPF FUND	3,091,061.00	2,890,006.00
	TOTAL (B)	3,091,061.00	2,890,006.00
	BALANCE BEING EXCESS OF INCOME / (EXPENDITURES) (A - B)	(1,354,235.00)	(898,571.00)
	BALANCE BEING SURPLUS/(DEFICIT) CARRIED TO ARIES, NAINITAL (DEFICIT)	(1,354,235.00)	(898,571.00)

For and on behalf of ARIES, Nainital

PLACE : HALDWANI
DATED : August 31, 2021

(REGISTRAR) (DIRECTOR)

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

BALANCE SHEET OF PENSION FUND AS AT 31st MARCH 2021

(Amount in "Rupees")

S. NO	PARTICULARS	Current Year For the year ended 31st March 2021	Previous Year For the year ended 31st March 2020
	A. LIABILITIES:		
1	**PENSION FUND:**		
	OPENING BALANCE	44,236,446.56	44,236,446.56
	ADD: PENSION FUND	70,120.00	-
	LESS: PENSION PAID	(16,757,926.00)	-
	TOTAL (1)	27,548,640.56	44,236,446.56
2	**RESERVES AND SURPLUS:**		
	OPENING BALANCE	21,979,271.94	23,397,667.94
	LESS: TRANSFERRED	-	(1,418,396.00)
	TOTAL (2)	21,979,271.94	21,979,271.94
3	**CURRENT LIABILITIES:**		
	TDS PAYABLE	-	31,650.00
	ARIES, NAINITAL (SURPLUS)	1,192,621.00	2,773,263.96
	ARIES, NAINITAL (BALANCING FIGURE)	15,714,132.22	5,837,024.26
	TOTAL (3)	16,906,753.22	8,641,938.22
	TOTAL LIABILITIES (A) (1 + 2 + 3)	66,434,665.72	74,857,656.72
	B. ASSETS:		
4	BANK BALANCE (SBI) A/C 311	64,630,952.70	65,160.70
5	BANK BALANCE (UBI) A/C 535	714,565.02	693,046.02
6	FDR IN SBI NAINITAL	-	-
7	ACCRUED INTEREST	869,222.00	-
8	TDS RECEIVABLE	219,926.00	-
9	ARIES, NAINITAL (PENSION FDR MATURITY)	-	74,099,450.00
	TOTAL ASSETS (B)	66,434,665.72	74,857,656.72

For and on behalf of ARIES, Nainital

PLACE : HALDWANI
DATED : August 31, 2021

(REGISTRAR) (DIRECTOR)

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

STATEMENT OF INCOME AND EXPENDITURE OF PENSION FUND FOR THE YEAR ENDED 31st MARCH 2021

(Amount in "Rupees")

S. NO	PARTICULARS	Current Year For the year ended 31st March 2021	Previous Year For the year ended 31st March 2020
	(A) INCOMES:		
1	INTEREST ON FDR INVESTMENTS	-	2,680,137.00
2	INTEREST ON BANK (UBI) A/C 535	21,194.00	96,222.00
3	INTEREST ON BANK (SBI) A/C 311	1,165,817.00	2,213.00
4	PRIOR PERIOD INCOME (INTEREST - UBI - 2019-20)	5,610.00	-
5	OPENING BALANCE DIFFERENCE	-	2,791.96
	TOTAL (A)	1,192,621.00	2,781,363.96
	(B) EXPENDITURES:		
1	BANK EXPENSES	-	8,100.00
	TOTAL (B)	-	8,100.00
	BALANCE BEING EXCESS OF INCOME / (EXPENDITURES) (A - B)	1,192,621.00	2,773,263.96
	BALANCE BEING SURPLUS/(DEFICIT) CARRIED TO ARIES, NAINITAL (SURPLUS)	1,192,621.00	2,773,263.96

For and on behalf of ARIES, Nainital

PLACE : HALDWANI
DATED : August 31, 2021

(REGISTRAR) (DIRECTOR)