



*Newsletter of the Physical Research Laboratory*

# THE SPECTRUM



## Image of the Month

**ISRO Structured Training Program (ISRO-STP 2023)  
on “Sun-Planet Interactions: A Space Weather Perspective”  
25-29 September, PRL Ahmedabad**

*October 2023 Issue*

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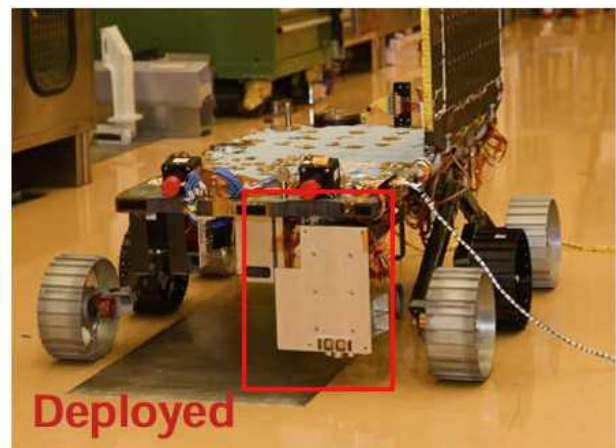
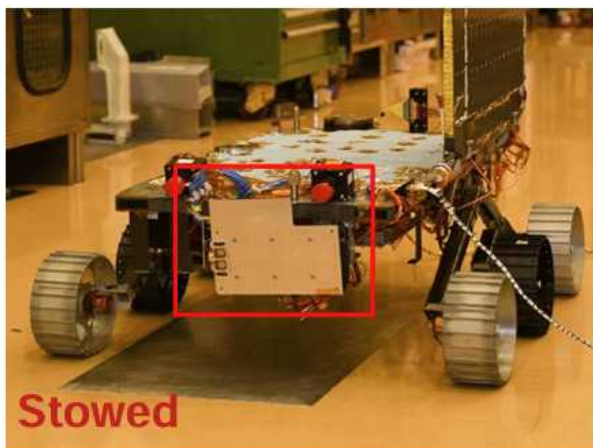
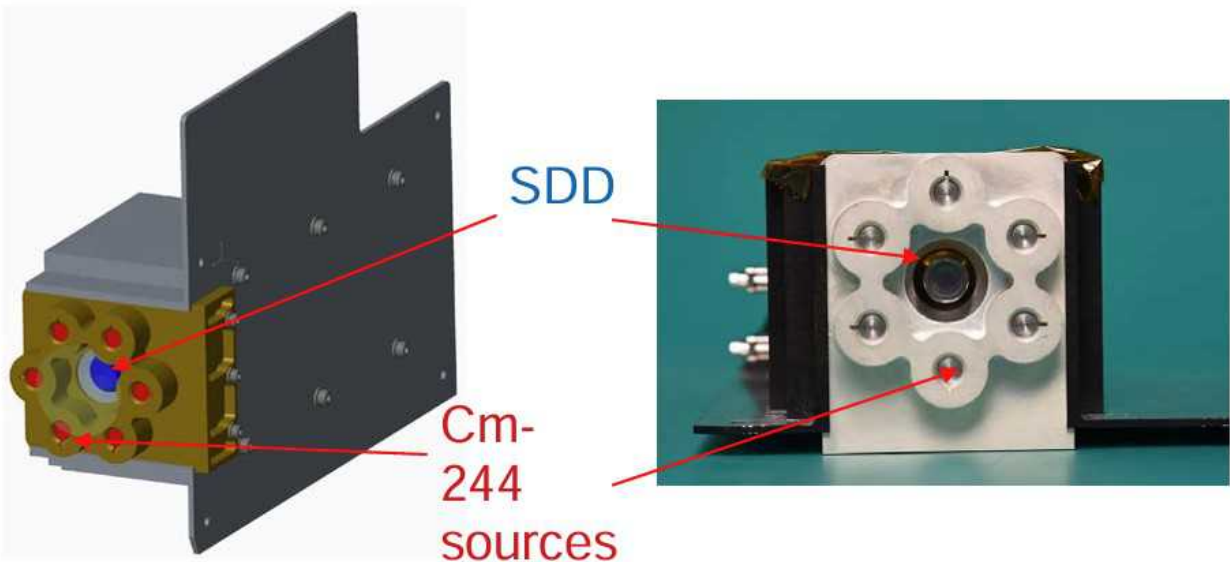
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## APXS onboard the Pragyaan rover: Experience of operations on the lunar surface

**Prof. Santosh V Vadawale**



It was literally a once-in-a-lifetime opportunity to be present in the ISRO Telemetry, Tracking, and Command Center (ISTRAC) to witness the first soft landing of the Chandrayaan-3 Vikram lander on 23rd August 2023. The final moments of the landing were truly nerve-wracking, reminiscent of the heart-breaking moments of the Chandrayaan-2 landing. The control room was jam-packed with all colleagues who had contributed directly and indirectly, closely and remotely, towards realizing the mission. The Vikram lander gracefully touched down on the lunar surface, and the entire center erupted in absolute joy. Everyone was congratulating each other, irrespective of whether they were close colleagues or only remote acquaintances. The celebrations lasted a jubilant couple of hours, but most of our excitement was yet to come! We stayed put in the control center even as the gathering started to disperse, ready to exercise our tasks of leading the Pragyaan rover to scientifically fruitful stroll on the surface of the Moon and the scientific operations of our payload, APXS (Alpha Particle X-ray Spectrometer), onboard the Pragyaan rover. This required the twenty-four-seven presence of our team in the control center for the next 12 days, a challenge we were delighted to take up!



**Figure 1:** (top) APXS package and the source holder (bottom) APXS stowed and deployed configuration in the clean room

After the initial euphoria subsided, the mission team set to work, and the lander ramp was deployed by midnight. The deployment was visible in the lander camera, and everyone in the control room was ecstatic at the sight of the deployed ramp with the Pragyaan rover attached to it. Soon after that, the rover's solar panel was deployed, and the rover was released from the ramp by cutting the frangibolts (a special type of bolt that gets snapped on controlled heating). Successful completion of every event led to a big applause, and in no time, the Pragyaan rover was on the lunar surface. However, just at the first step on the lunar surface, the rover encountered the first hurdle! A small crater was visible ahead of the front right wheel of the rover. Discussions and deliberations started and continued among various teams on tackling this crater. Near the end of the communication window with the Vikram lander (there was a gap of about 6 hours every day when communication was not impossible), it was decided to stop further operations at night. A thorough review of possible options the next day suggested going through the crater (Figure 2) but in the real-time imaging mode! As per the pre-landing plan, this mode was meant to be used only during the landing phase and not during any later operations. However, considering the off-nominal situation of traversing through the crater, the real-time view mode was engaged.

Once the first hurdle was passed, it was time for the first operation of APXS on the 25th of August afternoon. We all were glued to our monitoring screens to verify that all instrument health parameters were normal. The detailed command sequences to initiate APXS power-on, deployment, observations, and stow-back were already stored onboard, and the command to initialize the sequence was issued from the control center. The first phase of the calibration plate observation went through as per the plan, and the deployment of the payload started among the loud cheers of all concerned team members. But then, suddenly, there was silence. The telemetry screen showed that the APXS payload was switched off. All of us were surprised and somewhat shocked, and the investigation of the cause started immediately. On detailed scrutiny of all the commands given by the rover computer, it was found that the unexpected switch-off of the APXS payload happened due to a late addition of a rover safety consideration, resulting in an inadvertent 'OFF' command given to the APXS. This was quickly rectified, and APXS's first successful scientific operation of APXS was carried out on 25th August from about 6:55 pm to 7:40 pm (IST).



**Figure 2:** Pragyaan rover passing through a small crater after descending down the ramp

Once the first observation was obtained, we expected the remaining journey to be as per the plan, which was devised after painstaking discussions over many years before the launch. According to this plan, each movement of the rover was limited to a maximum of five meters at a time. The time required to finalize the commands for the next movement (referred to as rover mobility) was about 5 hours. While the next mobility of the rover was being decided on the ground, the scientific payload operations and the data download would commence on the rover. Further, the rover needed to move toward the east to ensure that the solar panel always gets adequate sunlight. Thus, the rover was expected to move by about 5 m every 5 hours in an arc shape, first towards the east and then towards the north.

What happened was completely different. After the second mobility itself, the Pragyaan rover encountered a relatively large crater (Figure 3). Again, after lots of deliberation, it was decided to backtrack the rover and take an alternate route towards the east. In this case, again, a crater was visible in the rover camera after the next mobility. So, the rover was brought back to the original position within the sight of the lander camera. Fortunately, the APXS operations were smooth, and at each rover stop so far, we could obtain very good quality data from APXS. Now that the rover was visible again, we had an opportunity to capture the deployment of the APXS in video, and we did that with a special operation wherein we just deployed and stowed back the APXS (Figure 4).

In the meantime, the discussions continued about how and where to take the rover further away. There were many factors to consider - craters, boulders, slopes, shadow, power, communication, and more. Each team had some valid points against the course of action suggested by other teams for following the original plan of going in the east. Finally, everyone came to the consensus that continuing eastward would be precarious. The best option was to go in the opposite direction, i.e., to the west! There was one complication, though: the rover would have to move backward in this case for the solar panels to be oriented towards the Sun. So, at every stop, the rover would have to turn by 180 degrees, take pictures to plan the path ahead, turn again by 180 degrees, and then start the backward movement. But this seemingly complicated plan was considered safer than any other alternative. Once this was decided, the rover had a relatively straight movement for about forty meters. It was at a couple of stops during this movement that the rover took the iconic photograph of the Vikram lander.



Figure 3: A crater encountered by Pragyaan rover during its early mobility

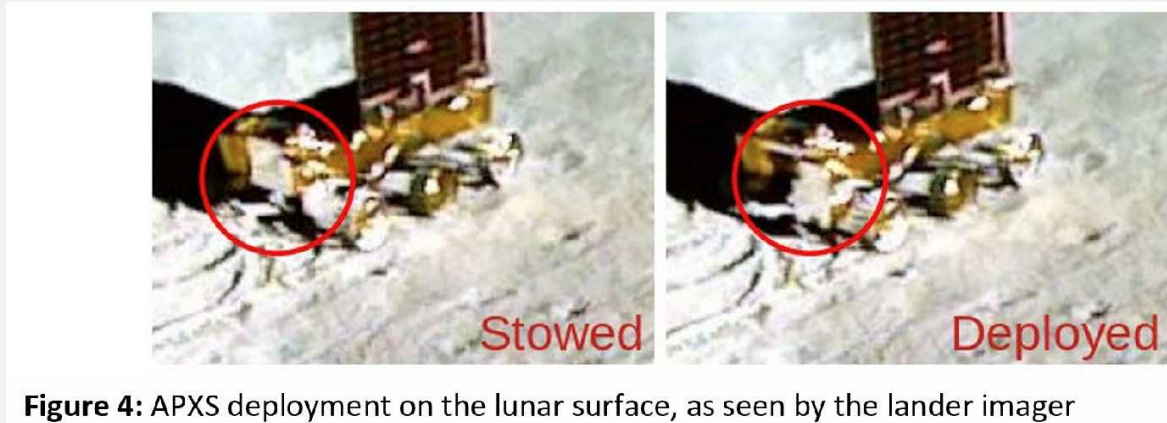
Ultimately, the rover reached an inclined terrain, where the intense reflected light from the slope prevented the rover navigation camera from seeing anything! Only a few days of rover operations remained at this stage, so it was decided to move north toward the eventual parking place. On the way, the rover had to negotiate with a few more craters and boulders and backtrack once for a short distance. It eventually reached a position considered safe for parking orientation such that the panel would receive sunlight directly during the next sunrise!

Despite a few hiccups during the early days, the rover could cover a total distance of more than 100 meters, as shown in Figure 5. The APXS was operated during a majority of the rover stops, resulting in a total of twenty-three scientifically useful observations. This fairly good number can provide concrete information on the local diversity (or lack thereof) in the region surrounding the landing site. The last APXS operation was on the 2nd of September, 2023.

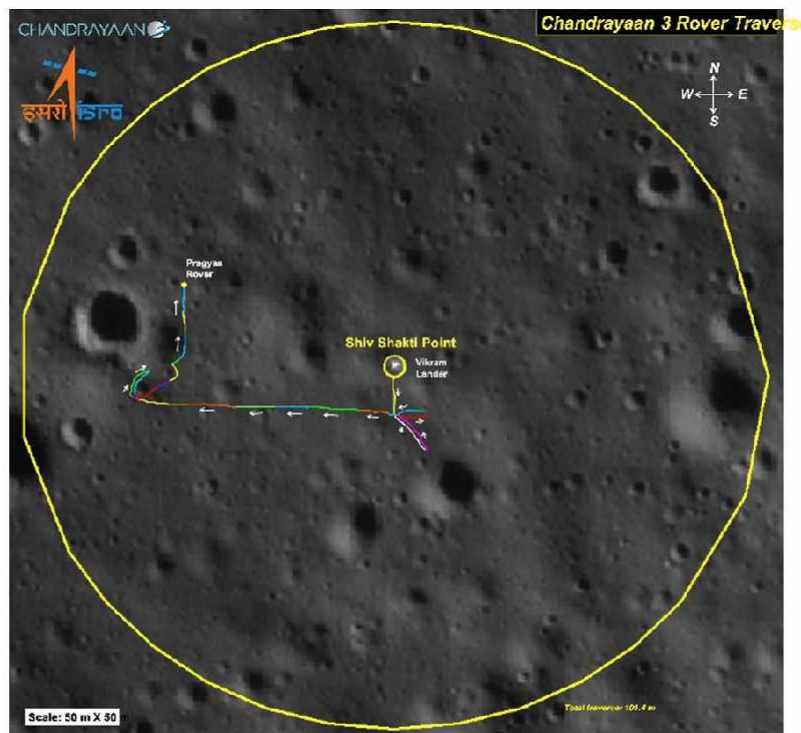
We expected the rover operations to continue for one more day, but the one-day early wrap-up was due to the preparation for the 'hop experiment' of the Vikram lander! We were hearing about the possibility of such an experiment during the last couple of days of the rover operations. Still, it was a pleasant surprise to know that it was finally decided to carry out the 'hop' on the night of the 2nd of September. After the successful 'hop', both the Pragyaan rover and the Vikram lander were put to sleep with wake-up logic enabled in anticipation that they may wake up on the second lunar day once the temperature and the solar power conditions are conducive, provided all the sub-systems survive the harsh and cold lunar night when the temperature was likely to reach to -180 C.

As we all know, no signal was received from the Vikram lander. Nevertheless, the Vikram lander and the Pragyaan rover have done their job splendidly during their first lunar day, which is what they were designed for. The Pragyaan rover had another scientific payload called LIBS (Laser-Induced Breakdown Spectroscope). Similarly, the Vikram lander had three scientific payloads: ChaSTE, ILSA, and Rambha-LP. These payloads have been successfully operated during the first lunar day and all of them have provided excellent scientific data.

The APXS, of course, has provided excellent data over the nine Earth days of operation. Currently, we are analyzing the data in detail to extract every possible information and to derive the scientific inference from it. We hope to get some really interesting results in the near future as a culmination of this exciting enterprise.



**Figure 4:** APXS deployment on the lunar surface, as seen by the lander imager



**Figure 5:** Path traversed by Pragyaan rover on the lunar surface covering total distance of ~101 m.

## The Author



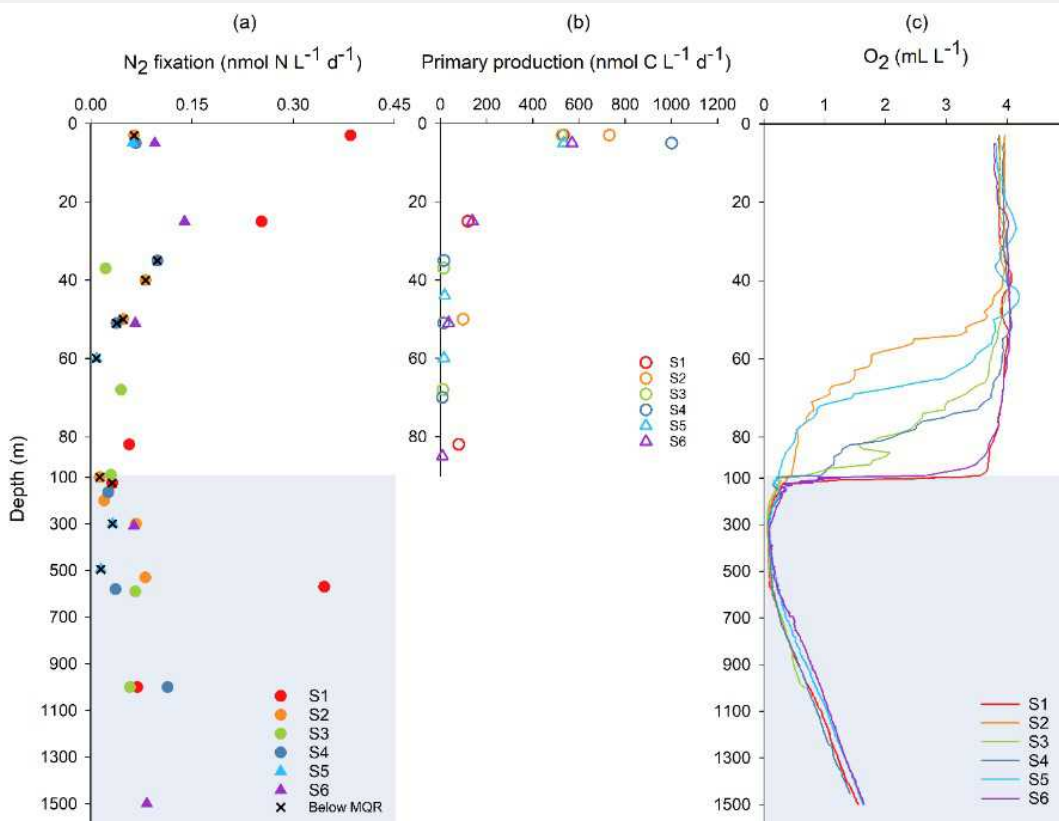
Himanshu Saxena

## The Bay of Bengal remains an enigmatic diazotrophic niche

(Himanshu Saxena, Deepika Sahoo, Sipai Nazirahmed, Diptaraj Chaudhari, Praveen Rahi, Sanjeev Kumar, Mar Benavides, Aswathy Vijaya Krishna, A. K. Sudheer, Arvind Singh)

The growth of marine phytoplankton (photosynthetic microorganisms) is primarily limited by the reactive forms of nitrogen. Dinitrogen ( $N_2$ ) fixing organisms (termed ‘diazotrophs’) supplement this need by providing a natural fertilizer—ammonium. Diazotrophs prefer stratified, warm, low oxygen, phosphate and iron-rich, but reactive nitrogen-deficit waters. The meagrely explored oligotrophic Bay of Bengal (the northeastern Indian Ocean) with oxygen minimum zone in its subsurface waters, excess phosphate relative to reactive nitrogen and high iron input could be a potential niche for diazotrophy. Therefore, we examined  $N_2$  fixation rates along with primary production, cyanobacterial community composition and their potential environmental controlling parameters in the euphotic zone, the oxygen minimum zone and below the oxygen minimum zone down to 1,500 m depth in the Bay of Bengal.

Our results indicate that despite most prerequisites available for diazotrophic activity,  $N_2$  fixation rates were low ( $0.02$  to  $0.38$   $nmol\ N\ L^{-1}\ d^{-1}$ ) and supported less than 2% of primary production in the Bay of Bengal. Despite conducive conditions for diazotrophy in the Bay of Bengal, the reason for the relatively low euphotic zone and oxygen minimum zone  $N_2$  fixation rates remained unclear and enigmatic. Surprisingly, significantly higher  $N_2$  fixation rates occurred below the oxygen minimum zone ( $> 600$  m depth), ranging from  $0.06$  to  $0.11$   $nmol\ N\ L^{-1}\ d^{-1}$  where oxygen concentrations ranged between  $0.5$  and  $1.6$   $mL\ L^{-1}$ , rather than within the oxygen minimum zone where rates ranged from  $0.02$  to  $0.08$   $nmol\ N\ L^{-1}\ d^{-1}$  and oxygen concentrations were  $\leq 0.5$   $mL\ L^{-1}$ . Euphotic zone  $N_2$  fixation showed seasonality in the Bay of Bengal with increasing rates from spring to summer season, perhaps owing to increasing iron flux as the summer monsoon approaches its peak. Thus, our study provides additional evidence that  $N_2$  fixation is feasible (low but persistent) in dark marine places with abundant oxygen in conjunction with the surface ocean.



Source/Reference of the Work:  
<https://doi.org/10.1029/2023JG007687>

**Figure Caption:** Vertical profiles of (a) average  $N_2$  fixation rates, (b) average primary production and (c)  $O_2$  concentrations in the euphotic (white background) and aphotic zone (shaded background). Circles represent the coastal Bay stations and triangles represent the central Bay stations. Overlaid cross symbols represent the rates below minimum quantifiable rates (MQR). Note that the y-axis of the euphotic zone is extended.



## Signature of Two-Step Non-Linear Interactions Associated to Zonally Symmetric Waves During Major Sudden Stratospheric Warmings

(Gourav Mitra, Amitava Guharay, Fede Conte, Jorge Chau)

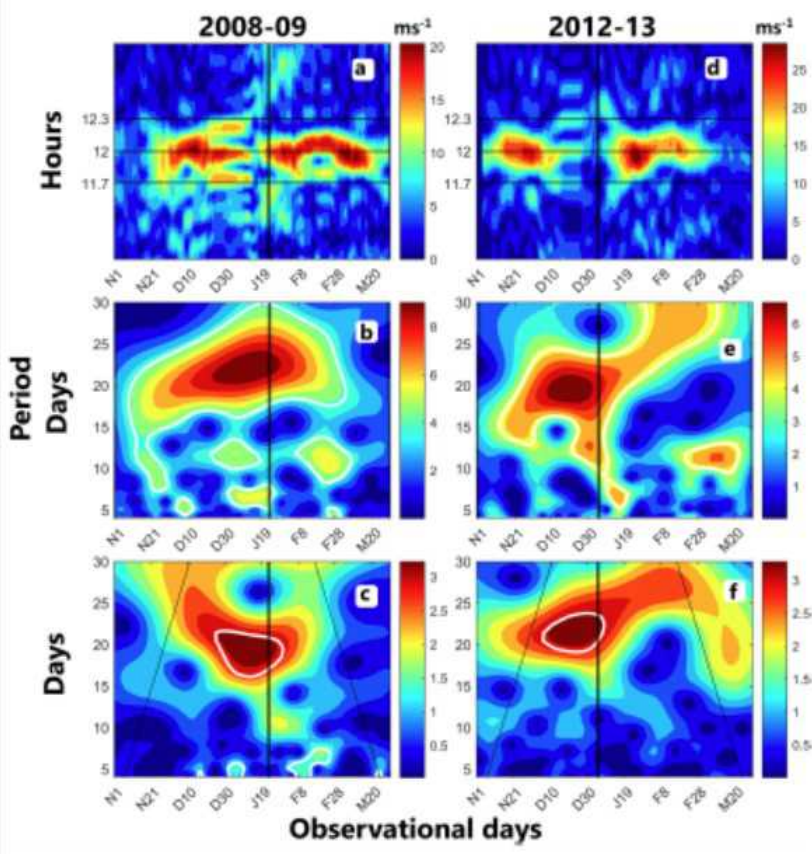
### The Author



Gourav Mitra

The sun-synchronous semidiurnal tide (SW2) is a major wave in the middle and high latitude mesosphere and lower thermosphere (MLT). Sudden stratospheric warming (SSW) is a polar winter hemispheric event characterized by enhanced planetary wave (PW) activity. Non-linear interaction between the two waves produces secondary waves whose frequencies are sum and difference of the primary waves. Further, the secondary waves, having a frequency closely spaced to the tidal frequency, beat with the tide, resulting in modulation of the tidal amplitude by the PW's period due to the non-linear interaction. The spectral analysis of specular meteor radar-derived hourly winds supports this notion, and hence provides evidence for non-linear interactions in the MLT. The dominant PW involved in the interaction is found to be zonally symmetric. The non-linear interaction between the stationary PW and propagating PW in the stratosphere plays an important role in forcing the zonally symmetric component, that can reach MLT altitudes. Furthermore, non-linear interaction between SW2 and the zonally symmetric PW produces the observed secondary waves in the MLT in the form of side bands in radar spectra. Overall, the present study provides the first observational evidence of a two-step non-linear interaction during SSWs.

**Source/Reference of the Work:** <https://doi.org/10.1029/2023GL104756>



**Figure Caption:** (a) Evolutionary Lomb Scargle amplitude spectra (semidiurnal tide [ST] period range) and (b) wavelet amplitude spectra (planetary wave period range) of the U at 90 km, and (c) wavelet spectra of the instantaneous ST amplitude at 90 km using meteor radar observations at Andenes, from 1 November 2008 to 31 March 2009. (d-f) Represent the same as (a-c) but during 2012-13. The solid vertical line represents the peak warming day and the thin tilted line represents the cone of influence. The white curve in the wavelet spectra represents the 95% confidence level. Please note the change of scale in the colorbars corresponding to each subplot while comparing. The letters N, D, J, F, and M in the x-axis denote November, December, January, February and March; the subsequent number indicates the day of the given month.

## ISRO Structured Training Program (ISRO-STP 2023) on “Sun-Planet Interactions: A Space Weather Perspective”

PRL conducted ISRO Structured Training Program (ISRO-STP 2023) on the theme of “Sun-Planet Interactions: A Space Weather Perspective” during 25-29 September 2023. A total of 45 Scientists/Engineers of SD/SE/SF/SG level from various ISRO/DOS centres participated in the training program. There were 38 participants from ISRO/DOS centres other than PRL. Lectures in the STP covered fascinating topics from solar variability, space weather, planetary atmospheres, ionospheres, magnetospheres, and also important aspects of instrumentation and modelling techniques to investigate Sun-Planet interactions. Keeping the theme of this STP in mind, the lectures were carefully curated under the following themes.

1. The Sun and solar wind
2. The Sun-Earth interactions and solar wind
3. Extra-terrestrial space weather
4. Space missions from India

Lectures were delivered on ongoing developments and the upcoming missions in the space weather domain specifically; Aditya-L1, Chandrayaan-3, dual-satellite Aeronomy mission DISHA, and missions to Venus and Mars to provide the participants an overview on the solar system exploration program of India. Participants were divided into 8 different teams and projects were carried out on focused topics on the themes mentioned above using the experimental and simulation facilities at PRL. It is important to mention that, all the lectures in this STP were delivered by PRL scientists which shows the range of expertise available in PRL, which is rightfully called as the “Cradle of space research” in India.

As a part of STP, a public lecture entitled “Water resource problems of India: Importance of iosotope fingerprinting” was arranged on 26 September 2023 evening. Participants were taken to a science based drama entitled ‘The uncertainty of principles’ on 27 September 2023 evening. On the fourth day of STP (28 September 2023), participants were taken to Gujarat Science City, hosted by science city authorities and the program was named as “A day with ISRO Scientists”. Visits were arranged to aquatic gallery, robotics gallery followed by IMAX 3D movie “Landing on the moon”. Participants provided feedback and suggestions to the science city administration on the possible developments for the academic benefit of students who will be visiting science city.

On the last day (29 September 2023), all teams gave short presentations of their project work. The feedback from participants was positive and all of them enjoyed the learning process during this STP and they were very happy for participating in this STP.



## PRL Amrut Rajbhasha Vyakhyaan - 4



"पीआरएल अमृत राजभाषा पाठ्यक्रम (PARV)" का चतुर्थ व्याख्यान 20 सितंबर, 2023 को हुआ। प्रख्यात आईआरएस अधिकारी डॉ. अभय कुमार ठाकुर, जो वर्तमान में बनारस हिंदू विश्वविद्यालय में वित्त अधिकारी के रूप में कार्यरत हैं, विशिष्ट वक्ता थे। डॉ. ठाकुर ने देश के विभिन्न क्षेत्रों में सहायक आयकर आयुक्त, आयकर उपायुक्त, संयुक्त आयकर आयुक्त, अपर आयकर आयुक्त और आयकर आयुक्त जैसे महत्वपूर्ण पदों पर कार्य किया है। उन्होंने मानव संसाधन विकास मंत्रालय और विश्वविद्यालय अनुदान आयोग द्वारा गठित कई समितियों के विकास और प्रभावी कामकाज में महत्वपूर्ण योगदान दिया है। केंद्रीय विश्वविद्यालयों में अतिरिक्त-बजटीय संसाधनों को जुटाने और उपयोग के साथ-साथ वित्त और प्रशासनिक संसाधनों को बढ़ाने के संबंध में नीति दस्तावेज तैयार करने में उनका योगदान महत्वपूर्ण रहा है। डॉ. ठाकुर ने निवेश समितियों के सदस्य के रूप में भी महत्वपूर्ण योगदान दिया है।

अपने व्याख्यान के दौरान डॉ. अभय कुमार ठाकुर ने सीमित वित्तीय संसाधनों के कारण हर संगठन के सामने आने वाली वित्तीय प्रबंधन की चुनौतियों पर जोर दिया। वित्तीय प्रबंधन की सर्वोपरि जिम्मेदारी संगठन के भीतर प्रत्येक इकाई को संसाधनों के समय पर और उचित आवंटन में निहित है। इस संदर्भ में, न केवल संसाधन वृद्धि की संभावनाओं को लगातार तलाशना जरूरी है, बल्कि खर्चों के लिए एक सुसंगत और सुनियोजित दृष्टिकोण भी सुनिश्चित करना जरूरी है।

उन्होंने प्राचीन भारतीय समाज और धरोहर से अंतर्दृष्टि प्राप्त करने की प्रासंगिकता को महत्व देते हुए, और आचार्य कौटिल्य के इस दावे को उद्धृत किया कि खजाना सभी राजनीतिक प्रणालियों का मूलभूत स्तंभ है। डॉ. ठाकुर ने कौटिल्य के अर्थशास्त्र की ओर संकेत दिया, जो धन की निरंतर वृद्धि के लिए विभिन्न नीतियों का प्रस्ताव देता है। समकालीन समय में, कुशल निवेश प्रथाएं और विवेकपूर्ण व्यय प्रबंधन किसी संस्थान को वित्तीय रूप से मजबूत कर उसके उज्ज्वल भविष्य को सुरक्षित कर सकते हैं।

इस ज्ञानवर्धक व्याख्यान के बाद, एक चर्चात्मक प्रश्न और उत्तर सत्र ने प्रतिभागियों को विषय वस्तु की गहन समझ और व्यक्तिगत अंतर्दृष्टि प्राप्त करने का अवसर प्रदान किया।

The 4th lecture of "PRL Amrut Rajbhasha Vyakhyaan (PARV)" took place on September 20, 2023. Dr. Abhay Kumar Thakur, an esteemed IRS officer, currently serving as the Finance Officer at Banaras Hindu University, was the distinguished speaker.

Dr. Thakur has held pivotal positions such as Assistant Commissioner of Income Tax, Deputy Commissioner of Income Tax, Joint Commissioner of Income Tax, Additional Commissioner of Income Tax, and Commissioner of Income Tax across various regions in the country. He has significantly contributed to the development and effective functioning of numerous committees constituted by the Ministry of Human Resource Development and the University Grants Commission. His contributions have been vital in formulating policy documents regarding the mobilization and utilization of extra-budgetary resources in Central Universities, as well as enhancing finance and administrative resources. Dr. Thakur has also made substantial contributions as a member of investment committees.

During his lecture, Dr. Abhay Kumar Thakur emphasized the challenges of financial management faced by every organization due to limited financial resources. The paramount responsibility of financial management lies in the timely and appropriate allocation of resources to each unit within the organization. In this context, it is imperative not only to continually explore possibilities for resource augmentation but also to ensure a consistent and well-planned approach to expenses.

He underscored the relevance of drawing insights from ancient Indian society and heritage, quoting Acharya Kautilya's assertion that the treasury is the fundamental pillar of all political systems. Dr. Thakur pointed to Kautilya's Arthashastra, which offers various strategies for the continual augmentation of funds. In contemporary times, efficient investment practices and judicious expense management can fortify an institution financially, securing its bright future.

Following this enlightening lecture, an interactive Question and Answer session provided participants with the opportunity to delve deeper into the subject matter and gain personalized insights.





## Venus Science Conference 2023 Physical Research Laboratory, Ahmedabad



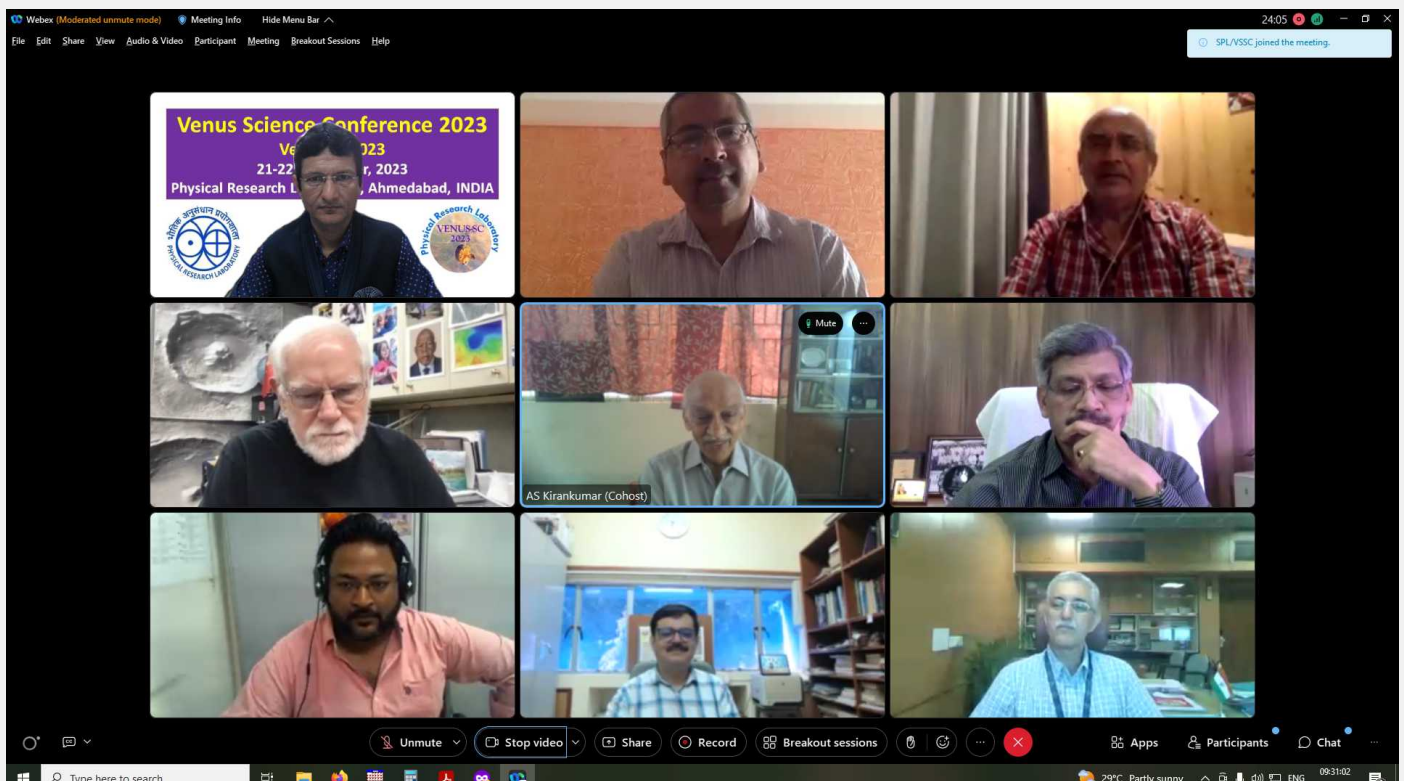
### Dr. Jayesh Pabari



Researchers have been working in the area of planetary sciences for many decades and explore various planets like Venus, Mars, Jupiter, Saturn etc. However, Venus, the sister planet of Earth, has been of interest to space scientists for different reasons. There are some open research problems like evolution of Venusian surface, unknown UV absorber, lightning, super-rotation and space weather on Venus. The observations on Venusian science has been from the time of Venera in 1960s and many missions like Mariner, Pioneer Venus, Vega, Magellan, Venus Express, Akatsuki, IKAROS have provided lots of data to the community. In addition, other unintended missions like Galileo, Cassini, MESSENGER, Parker Solar Probe, BepiColombo and Solar Orbiter have also given flyby observations of Venus. The data analysis from the missions bring different scientific outcomes related to planet Venus and appear in the literature. Some conferences are organized over the globe to discuss the Venusian science, either within a planetary conference or as a dedicated conference.

Recently, the Physical Research Laboratory (PRL) has organised the THIRD conference on Venus Science, Venus-SC 2023 (online) during 21-22 September 2023 IST. It focused on modelling, observations, data analysis, conceptual instrument design and scientific experiments for Venus exploration. The major research areas covered in the conference were surface, atmosphere, clouds, lightning, habitability, ionosphere, interplanetary dust, and solar wind interaction with the planet. Such gathering provides an opportunity to interact among the community over the globe and also, collaborate with people working in similar fields over a period of time.

Formally 180 delegates had registered for the conference, which included speakers for oral presentations, short oral presentations and other attendees. The oral presentations had 17 talks from universities/institutes within and outside India. The short oral presentations have 16 talks from India institutions. A few examples of the talks are



Evolution of Venus, Latest results from Akatsuki radio occultation, Search of Habitability in Venusian atmosphere, Ground Based Optical Observations of Lightning on Venus, Venus Climate, Instrument for Venus Atmosphere Studies, Dust Observations by Solar Orbiter and Metallic Ion Layer in Venusian Atmosphere. This year, we have included the dedicated time slots for scientific discussions among the domain scientists for each in each session. The panellists have suggested different science questions which should be addressed by future Venus Orbiter mission.

The outside India included universities/institutes from places like US, UK, Japan, Sweden, Taiwan, Germany, France and Norway. The centres/institutes from within India covered SAC, SPL, PRL, Amity Uni., NARL, St.Aloysius College, IIT Indore, NISER and J. S. Uni. The Venus Science Conference included speakers spanning 4 time zones.

Honourable Shri A. S. Kiran Kumar (Council Chair, PRL) had graced the inaugural session. There were 6 sessions covering all mentioned research areas. The session chairs were well experienced in the domain and they were from various ISRO/Non-ISRO centres. There was a concluding session at the end of the conference. Many people including Prof. Anil Bhardwaj (Director, PRL), Prof. D. Pallamraju (Dean, PRL), the SOC and LOC members, Dr. Bhushit Vaishnav (Head, Academic Services), Shri Dinesh Mehta, IT team, electrical team and other members had helped as and when needed for the conference.



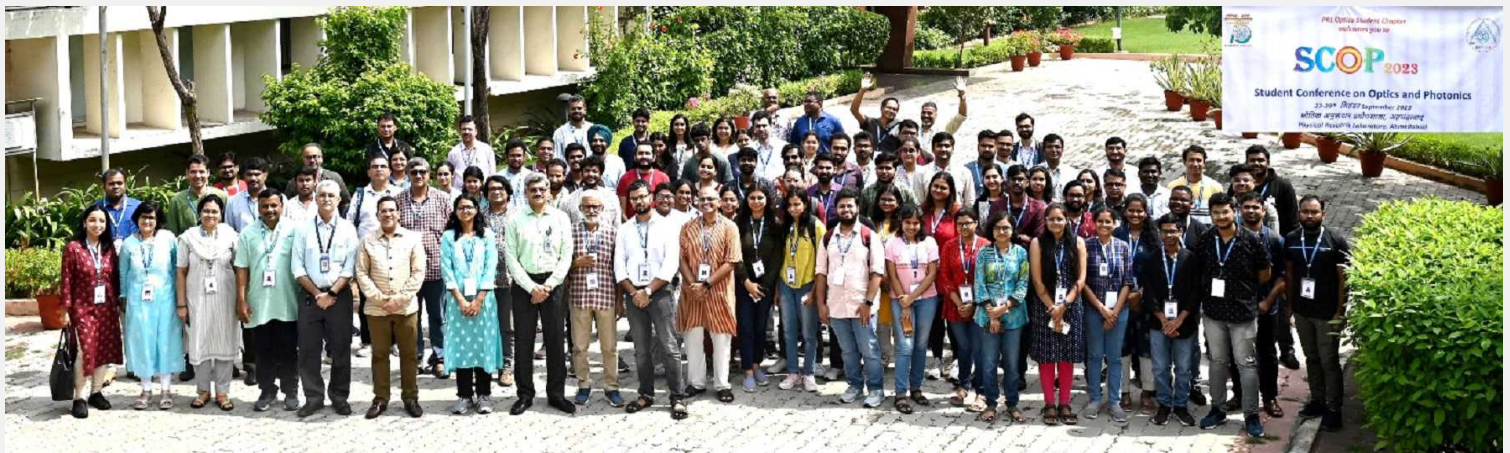
Photograph of the support centre

## Student Conference on Optics and Photonics (SCOP-2023) (27th-29th September, 2023)

In a spectacular convergence of knowledge and inspiration, Physical Research Laboratory Student chapter recently hosted an unforgettable 8th edition of Student Conference on Optics and Photonics (SCOP) 2023 that left an indelible mark on attendees. The "SCOP-2023," held from 27th-29th September 2023, welcomed an array of leading experts, researchers, and students in the field, creating an electrifying atmosphere of knowledge and innovation.

The conference began with an inspiring inauguration, graced by esteemed figures, PRL Director, Prof. Anil Bhardwaj, Dean, Prof. D. Pallamraju and Registrar, Prof. R.D. Deshpande, along with all the participants of the conference.

Distinguished keynote speakers delved into cutting-edge advancement in optics and photonics, shedding light on topics such as laser technology, quantum optics, optical communications, nano-photonics, bio-photonics, and optical materials, paving the way for new perspectives and breakthroughs. An interactive panel discussion titled "Career Opportunities in the Field of Optics and Photonics in Research after PhD" engaged experts from academia and industry, and students in thought-provoking discussions. Students and researchers seized the opportunity to present their pioneering work through presentations and poster sessions, fostering a vibrant environment for learning and collaboration.



Day 1: Welcome of all participants to SCOP2023.

As part of SCOP-2023, a special cultural evening which included "The Magic show" by Prof. Goutam K. Samanta from PRL, showing his life and career journey in magical form and a scientific drama "The Uncertainty of Principles" performed by the theatre group 'Kalyani Mukhosh'-a group of scientists of SNBNCBS and faculty members from IISER Kolkata, mesmerised the audience with their spectacular performances. The play showcases the conflict between science and the organized religion, and juxtaposes the ideology and thought process of a young scientist against the society still deeply ensconced in the irrationalities and insecurities that plague most human minds subjected to the unpredictability of life.



Panel discussion, interactive session.



Magic show by Prof. G. K. Samanta.



Kalyani Mukhosh Group

As the conference drew to a close, the resounding sense of purpose and inspiration among attendees was evident. It was an extraordinary gathering that has undoubtedly fuelled the flame of curiosity and innovation, promising a brighter future for the world at large.

Link for SCOP Website: <https://prlstudentchapter.org.in/>

Link for abstract book of SCOP 2023: [https://drive.google.com/file/d/15oKIYvpb\\_NM1z\\_6erRQsyP6kJrWV2yWN/view](https://drive.google.com/file/d/15oKIYvpb_NM1z_6erRQsyP6kJrWV2yWN/view)



Closing Ceremony



## PRL Ka Amrut Vyakhyaan - 84




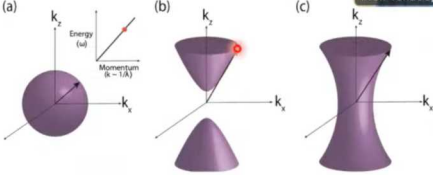
Via **webex**

### Hyperbolic Metamaterial

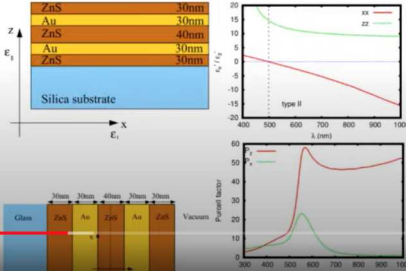
$$k_x^2 + k_y^2 + k_z^2 = \omega^2/c^2 \quad \frac{k_x^2 + k_y^2}{\epsilon_{zz}} + \frac{k_z^2}{\epsilon_{xx}} = \frac{\omega^2}{c^2}$$

$$\epsilon_{\text{HMM}} = \begin{pmatrix} \epsilon_{\perp} & 0 & 0 \\ 0 & \epsilon_{\perp} & 0 \\ 0 & 0 & \epsilon_{\parallel} \end{pmatrix} \quad \begin{aligned} \epsilon_{\perp} &= f\epsilon_{\text{Ag}/\text{Au}} + (1-f)\epsilon_{\text{ZnS}} \\ \epsilon_{\parallel} &= \frac{\epsilon_{\text{Ag}/\text{Au}}\epsilon_{\text{ZnS}}}{f\epsilon_{\text{ZnS}} + (1-f)\epsilon_{\text{Ag}}} \end{aligned}$$





ZnS	10nm
Au	20nm
ZnS	40nm
Au	30nm
ZnS	30nm
Silica substrate	





84th Amrut Vyakhyaan was delivered by Prof. Venu Gopal Achanta, (Director, CSIR-National Physical Laboratory (CSIR-NPL), New Delhi) on 27th September 2023. He spoke on the topic "Metamaterials for light-matter interaction".

Metamaterials are designed structures with sub-wavelength features constituents. With unique electromagnetic responses, they can be realized for different applications as well as basic physics studies. After a brief introduction to metamaterials, the structures and their applications in light-matter interaction at nanoscale dimensions were presented.

The Vyakhyaan was also attended by the participants of the 8th Student Conference on Optics and Photonics (SCOP), organized by the Physical Research Laboratory (PRL). Prof. Achanta interacted with the participants of the conference, where he answered their queries.

You Tube Link: <https://www.youtube.com/live/3oJ6C-FuQbM?feature=share>

## हिंदी माह कार्यक्रम-2023

हिंदी माह 2023 के अंतर्गत दिनांक 14, 15 सितंबर 2023 को पीआरएल के नामित सदस्यों ने गृह मंत्रालय राजभाषा विभाग द्वारा पुणे, महाराष्ट्र में आयोजित हिंदी दिवस कार्यक्रम एवं तृतीय अखिल भारतीय राजभाषा सम्मेलन में भाग लिया। दिनांक 19.09.2023 से पीआरएल में हिंदी माह 2023 प्रारंभ हुआ। हिंदी माह 2023 के समिति द्वारा विभिन्न ज्ञानवर्धक, मनोरंजक कार्यक्रमों एवं प्रतियोगिताओं का आयोजन किया गया।

As part of Hindi Month 2023, on 14th and 15th September 2023, the nominated members of PRL participated in the Hindi Diwas Program and the Third All India Official Language Conference organized by the Department of Official Language, Ministry of Home Affairs in Pune, Maharashtra. Hindi Month 2023 started in PRL from 19.09.2023. Various informative, entertaining programs and competitions were organized by the Hindi Month 2023 Committee.

दिनांक 19.09.2023 को पीआरएल के सदस्यों के लिए कविता पाठ प्रतियोगिता रखी गई थी। इस अवसर पर गणमान्य दो कवि एवं 1 कवयित्री कवि सम्मेलन के लिए उपस्थित रहे। सभी ने इस कार्यक्रम का बहुत आनंद लिया।

A Kavita Path competition was organized for the members of PRL on 19.09.2023. On this occasion, two distinguished poets and one poetess were present for the Kavi Sammelan. Everyone enjoyed this program very much.

दोनों कार्यक्रमों में प्रतिभागियों एवं श्रोताओं ने पूर्ण उत्साह से भाग लिया।

In both the above events, contestants and audience participated with full enthusiasm.

दिनांक 21.09.2023 को ऑनलाइन हिंदी टंकण प्रतियोगिता का आयोजन किया गया था। इस दिन सुलेख प्रतियोगिता भी रखी गई थी।

Online Hindi typing competition was organized on 21.09.2023. Hindi Handwriting competition was also organized on this day.

दिनांक 26.09.2023 को आशभाषण और वाद-विवाद प्रतियोगिता का आयोजन किया गया था। वाद-विवाद प्रतियोगिता का विषय था, “कैशलेस अर्थव्यवस्था देश के विकास के लिए अच्छी है”। इस बार वाद-विवाद एक नव-स्वरूप में आयोजित किया गया।

Extempore and Debate competition was organized on 26.09.2023. The topic of the debate competition was, “Cashless economy is good for the development of the country”. This time the debate was organized in a new format.

इन सभी कार्यक्रमों में पीआरएल के सदस्यों ने उत्साहपूर्वक भाग लिया। हिंदी माह के अंतर्गत आयोजित विभिन्न कार्यक्रमों का विवरण आगामी अंकों में प्रकाशित किया जाएगा।

PRL members participated enthusiastically in all these programs. Details of various programs organized as a part of Hindi Month will be published in the upcoming issues.



गतिविधियों की कुछ झलकियां  
Glimpses of various Activities

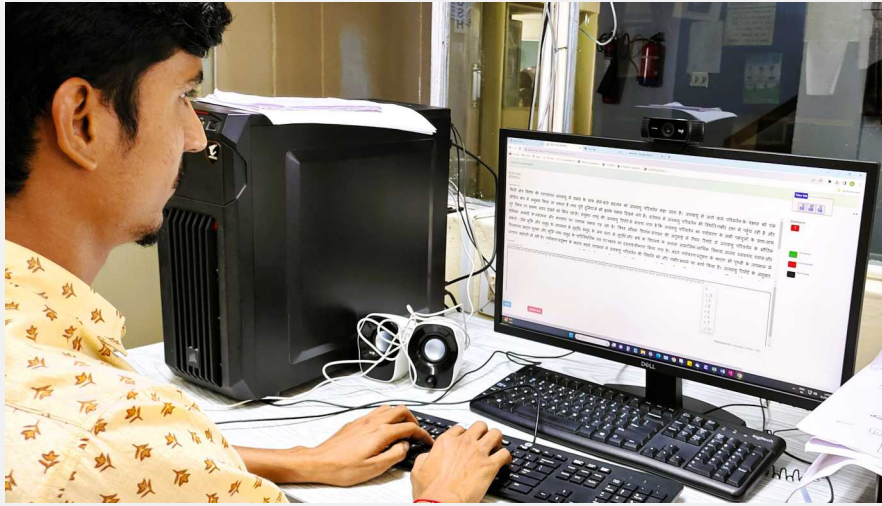
## Hindi Maah Celebrations at PRL Mt. Abu Observatory

पी.आर.एल हिंदी माह समिति की टीम ने हिंदी माह 2023 के उत्सव के हिस्से के रूप में कई प्रतियोगिताओं का आयोजन किया।

The PRL Hindi Maah committee team arranged various competitions as part of the celebration of Hindi Month 2023.

सहायक और संविदा कर्मचारियों से जुड़े कार्यक्रम पहली बार हुए। हिंदी टाइपिंग, सुलेख और चित्र वर्णन जैसी विभिन्न प्रतियोगिताओं में पीआरएल माउंट आबू के कर्मचारियों की भागीदारी रही।

Events involving auxiliary and contractual staff took place for the first time. There were participation of PRL Mount Abu staff in various activities, such as Hindi typing, Sulekh.



हिंदी टंकण प्रतियोगिता, पीआरएल माउंट आबू  
Hindi Tankan Pratiyogita, PRL Mount Abu



पी.आर.एल माउंट आबू सहायक रसोई  
कर्मचारी श्री गणपत सिंह सुलेख प्रतियोगिता  
में भाग लेते हुए |  
PRL Mount Abu cooking staff member Mr.  
Ganpat Singh participating in Sulekh  
pratiyogita.

**PRL Monthly Publications Digest (September 2023)****Astronomy & Astrophysics Division [2]**

1. B. Mondal, S. V. Vadawale, G. D. Zanna, N. P. S. Mithun, A. Sarkar, H. E. Mason, P. Janardhan, A. Bhardwaj, 2023, Evolution of Elemental Abundances in Hot Active Region Cores from Chandrayaan-2 XSM Observations, *The Astrophysical Journal*, Date of Publication: 27/09/2023
2. A. Saha, A. Tej, S. D. Palacio, M. D. Becker, P. Benaglia, I. Chandra CH, P. Prajapati, 2023, Search for particle acceleration in two massive Wolf-Rayet stars using uGMRT observations, *MNRAS*, Date of Publication: 12/09/2023

**Atomic Molecular and Optical Physics Division [3]**

1. K. Sugisaki, V. S. Prasanna, S. Ohshima, T. Katagiri, Y. Mochizuki, B. K. Sahoo, and B. P. Das, 2023, Bayesian phase difference estimation algorithm for direct calculation of fine structure splitting: accelerated simulation of relativistic and quantum many-body effects, *Electron. Struct.* 5 035006 (2023); 10.1088/2516-1075/acf909, Date of Publication: 25/09/2023
2. S. Singh, V. Kumar, V. Sharma, D. Faccio, G. K. Samanta, 2023, Near-Video Frame Rate Quantum Sensing Using Hong–Ou–Mandel Interferometry, *Advanced Quantum Technology*, 2300177 (2023), Date of Publication: 21/09/2023
3. H. X. Liu, Y. M. Yu, B. B. Suo, Y. Liu, and B. K. Sahoo, 2023, Investigating properties of heavy and superheavy atomic systems with p<sup>3</sup> configurations, *Phys. Rev. A* 108, 032804 (2023) <https://doi.org/10.1103/PhysRevA.108.032804>, Date of Publication: 05/09/2023

**Geosciences Division [4]**

1. R. A. Shah, A. Rahman, M. G. Yadava, S. Kumar, 2023, Mid-late Holocene palaeoclimate and biogeochemical evolution of Wular Lake, Kashmir Valley, India, *Journal of Quaternary Science*, Date of Publication: 22/09/2023
2. A. Singh, A. Patel, R. Satish, S. N. Tripathi, N. Rastogi, 2023, Wintertime oxidative potential of PM<sub>2.5</sub> over a big urban city in the central Indo-Gangetic Plain, *Science of The Total Environment*, 167155, Date of Publication: 20/09/2023
3. H. Saxena, D. Sahoo, S. Nazirahmed, D. Chaudhari, P. Rahi, S. Kumar, M. Benavides, A. Vijaya Krishna, A. K. Sudheer, A. Singh, 2023, The Bay of Bengal: An Enigmatic Diazotrophic Niche, *JGR-Biogeosciences*, Date of Publication: 14/09/2023

4. S. Chowdhury, E. Raes, C. Hörstmann, A. Ahmed, C. Ridame, N. MetzI, P. S. Bhavya, T. Sato, T. Shiozaki, S. Bonnet, C. R. Löscher, A. Singh, M. Benavides, 2023, Diazotrophy in the Indian Ocean: Current understanding and future perspectives, Limnology and Oceanography Letters, Date of Publication: 01/09/2023

### **Space & Atmospheric Sciences Division [3]**

1. G. Mitra, A. Guharay, J. F. Conte and J. L. Chau, 2023, Signature of Two-Step Non-Linear Interactions Associated to Zonally Symmetric Waves During Major Sudden Stratospheric Warmings, Geophysical Research Letters, Date of Publication: 29/09/2023

2. K. Venkatesh, D. Pallamraju, T. K. Pant, P. Suryawanshi, 2023, Parametric dependence of topside ionospheric empirical scale height and electron density profiles in neQuick2 model over the equatorial and low latitudes and its consequences on the estimation of TEC, Journal of Geophysical Research, Space Physics, Date of Publication: 01/09/2023

3. K. Rajagopal, S. Ramachandran, R. K. Mishra, 2023, Roadside measurements of nanoparticles and their dynamics in relation to traffic sources in Delhi: Impact of restrictions and pollution events, Urban Climate, Date of Publication: 01/09/2023.

## Awards & Honours

- (1) **Prof. Anil Bhardwaj, Director, PRL**, has been elected as the member of the **Board of Trustees** of the Basic Sciences Section of the **International Academy of Astronautics (IAA)**.
- (2) **Prof. Anil Bhardwaj, Director, PRL**, has been selected as a recipient of **Indian National Science Academy (INSA) Distinguished Lecture Series award** (for the year 2023).
- (3) **Dr. Arvind Singh, Associate Professor, Geosciences Division** of PRL has been selected for the **Indian National Science Academy (INSA), Associate Fellows (2023)**.
- (4) **Dr. Nandita Srivastava, Senior Professor, Udaipur Solar Observatory** of PRL has been nominated as a **member of the Research Advisory Committee** in the Indian Institute of Geomagnetism (IIG), Navi Mumbai, for a period of 3 years.
- (5) **Dr. Som Kumar Sharma, Professor, Space and Atmospheric Sciences Division** of PRL has been nominated as the **member of Board Of Studies (BoS), of the Indian Institute of Remote Sensing (IIRS)**, Dehradun.
- (6) **Dr. K. Durga Prasad, Scientist/Engineer-SF, Planetary Sciences Division** of PRL has been selected a **Secretary of the Planetary Sciences Section of the Asia Oceania Geosciences Society (AOGS)** from September 2023 to July 2024.
- (7) **Dr. J.P. Pabari, Associate Professor, Planetary Sciences Division** of PRL has been invited as a **Visiting Professor at the Electronics & Communication Engineering** Department of Charotar University of Science & Technology (**CHARUSAT**), Changa, Anand, Gujarat for a period of one year.

## Visitors

- 1) Mr. Tirtha Jyoti Kalita, Visiting Student visited PRL from 01.09.2023 to 25.09.2023 to work with Prof. Varun Sheel, Senior Professor of Planetary Science Division.
- 2) Mr. Paras Thacker, Visiting Student visiting PRL from 01.09.2023 to 29.02.2024 to work with Dr. Animesh Chatterjee, Ramanujan Fellow of Theoretical Physics Division.

The following personnel have visited PRL during September 2023 to meet Director:

1. Dr. S. D. Panchal, Director, GSET - GTU.
2. Dr. R. A. Thakker, Director, R & D Cell, GTU.
3. Dr. Gautam Makwana, Associate Professor, GTU.
4. Mr. Vinod Kuberkar, IIM Ahmedabad.

**Heartily welcome to our new members**



**NAME:** Mr. Doulat Singh Rathore

**DESIGNATION:** Light Vehicle Driver-A

**DATE OF JOINING:** 06.09.2023

**DIVISION/AREA:** Administration General



**NAME:** Mr. Modi Bhavikumar Lalitkumar

**DESIGNATION:** Light Vehicle Driver-A

**DATE OF JOINING:** 22.09.2023

**DIVISION/AREA:** Administration General



## Superannuation



<b>Name of the employee</b>	Shri Sandip Hashmukh Doshi
<b>Designation at the time of superannuation</b>	Technical Officer-D
<b>Date of Birth</b>	27.09.1963
<b>Date of Joining PRL</b>	20.05.1985
<b>Date of Superannuation</b>	30.09.2023

*We love all that you did. Now go and do all that you love.*



# Cyber Security Awareness – Password Safety

Adit M., Suraj R., Utsavi S., Parthiv P. Jigar R., CNIT Division

Set Different Password / PIN  
for  
Different Accounts... Be Like !!!!!!!!!!!!!!!



## ★ Important Password Tips ★

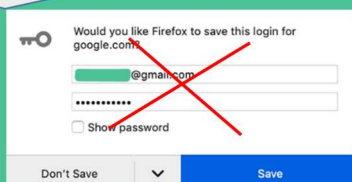
Do not rely on password alone.  
Use Multi-Factor Authentication.



Use passphrase that you can easily remember but difficult to guess.

Passphrase / Password:  
**OncelnABlueMoon@1**

Never save passwords in PC or Browser or other application.



Never Share Your Personal Details and Credentials.

**Compiled, Designed and Published by**

### **The Newsletter Team**

Prof. Navinder Singh    Chair  
Dr. Amitava Guharay    Co-Chair

### **Data Collection and Proofreading Team**

Dr. Satyendra Nath Gupta    Member  
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<https://www.prl.res.in/prl-eng/home>



Website (English)



Website (Hindi)

Physical Research Laboratory  
(A unit of Dept. of Space, Govt. of India)  
Navrangpura, Ahmedabad - 380009  
Phone: (079) 26314000  
Fax: (079) 26314900  
E-Mail: [director@prl.res.in](mailto:director@prl.res.in)

भौतिक अनुसंधान प्रयोगशाला  
(अंतरिक्ष विभाग की यूनिट, भारत सरकार)  
नवरंगपुरा, अहमदाबाद - 380009  
दूरभाष: (079) 26314000  
फैक्स : (079) 26314900  
ई - मेल: [director@prl.res.in](mailto:director@prl.res.in)