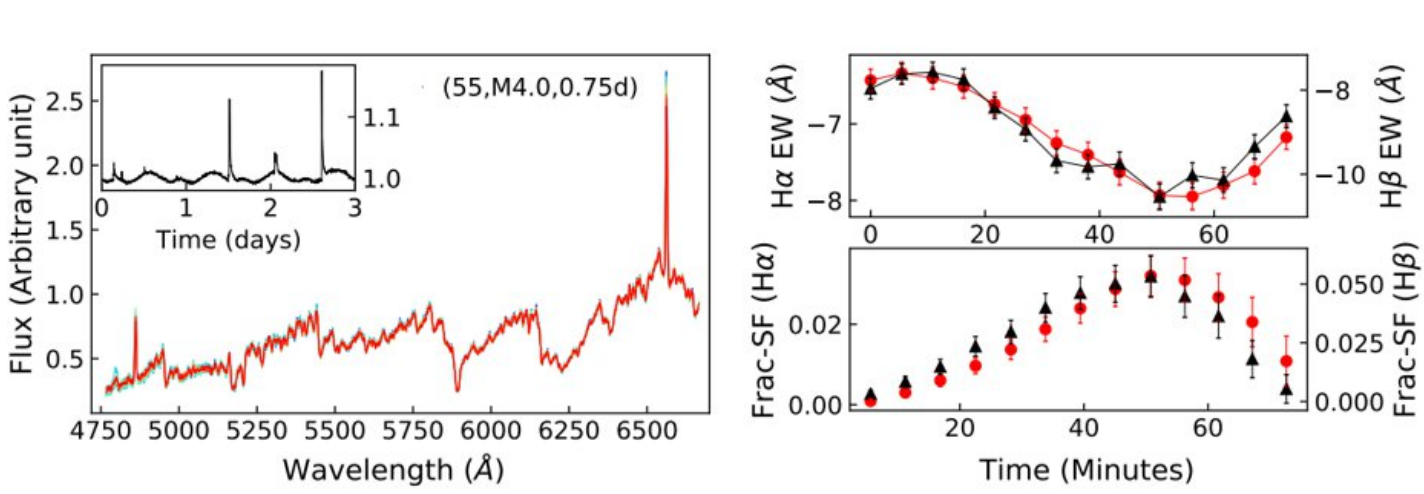
Newsletter of the Physical Research Laboratory

THE SPECTRUM

APXS payload on Pragyaan rover and ChaSTE payload on Vikram lander for Chandrayaan 3 (Courtesy: ISRO)



The figure shows the time-varying spectra of an M dwarf observed with an in-house developed MFOSC-P instrument mounted on the PRL's 1.2m telescope at Mt. Abu (Left panel). The photometric light curve is shown in inset. Top-right panel shows the time series of equivalent-widths of H-alpha (red circles) and H-beta (black triangles) emission which show a variability pattern. Such time variability is quantified using the fractional structure function (bottom-right panel) and is of great interest for the studies of M dwarfs.

Images of the Month

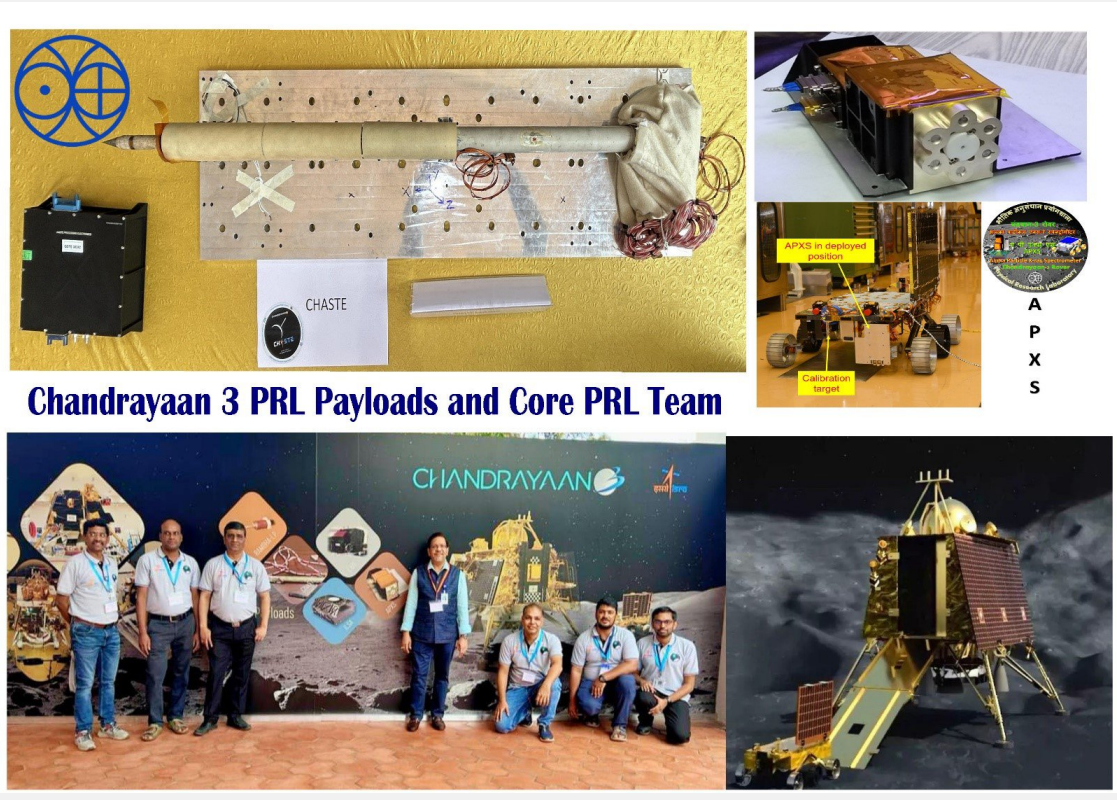
August 2023 Issue

Chandrayaan-3 landing on the Moon

History was created on August 23 at 18:04 IST when India's Chandrayaan-3 mission's robotic Lander, Vikram, touched down on the moon near its south pole. India became the fourth country of the Space League after the USSR (now Russia), USA, and China to achieve a soft lunar landing and the first country to land near the South Pole. The mission was launched on July 14, 2023, from SDSC SHAR, Sriharikota, carrying a landing module, Vikram, and a six-wheeled robotic rover, Pragyan.

After achieving this first milestone of the successful landing, the scientists are enthusiastically eying on the instruments operation and conducting proposed experiments. PRL has been leading space science and exploration programs in the country that began with the first rocket launch with sodium vapour release in 1963. PRL has vitally contributed to this Moon mission by conceptualizing, designing, and developing the two instruments, viz. ChaSTE (Chandra's Surface Thermophysical Experiment) on the Vikram Lander, and APXS (Alpha Particle X-ray Spectrometer) on the Pragyaan Rover. ChaSTE will provide us very crucial information about the temperature variation within the first 10 cm depth of the lunar regolith and also an estimate of the thermal conductivity of the lunar soil over the landing site. APXS will provide estimates of elemental and chemical composition of lunar soil and rocks. It is equipped to detect elements such as sodium, magnesium, aluminum, silicon, potassium, calcium, titanium, iron and minor constituents, such as, sulfur. APXS will have the privilege to roam a few tens of meters around the landing site and capture the data for the science team. On the next day of the landing of the Vikram lander on the lunar surface, ISRO tweeted that "All payloads on the propulsion module, lander module, and rover are performing nominally, Lander Module payloads ILSA, RAMBHA and ChaSTE are turned ON, Rover mobility operations have commenced & Rover payloads LIBS and APXS are turned ON". The instruments/ experiments are anticipated to operate for one lunar day, equivalent to 14 Earth days. These experiments will provide the first ever data near the lunar south pole which is going to be vital in improving our understanding of the thermal properties and elemental composition of the lunar surface.

PRL family takes this opportunity to congratulate the PIs and all the team members that are involved in contributing to the payloads aboard Chandrayan 3. We wish them all the best as we eagerly await the exciting science results from these experiments in the near future.



Chandrayaan 3 PRL Payloads and Core PRL Team

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Exploring the short-term variability of Hα and Hβ emissions in a sample of M dwarfs

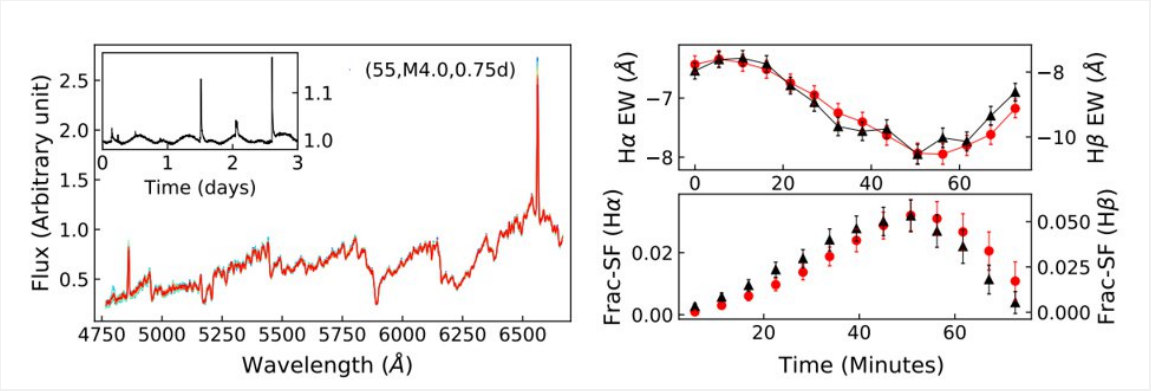
***(V. Kumar**, A.S. Rajpurohit, M.K. Srivastava, J. G. Fernandez-Trincado, and A. B. A. Queiroz)*

The Author

Vipin Kumar

M dwarfs are the most abundant stellar constituents in our Galaxy, contributing to ~70% of the total stellar content. M dwarfs are less massive (0.6-0.075 solar mass) and cooler stars (2500-4000 K) on the main sequence. A variety of them are expected to host sub-stellar objects, e.g., brown dwarfs and exoplanets; therefore, they have been a significant topic of attention in recent times. The magnetic fields in M dwarfs are the sole reason for stellar magnetic activity and play a fundamental role in the physics of stellar atmospheres. Therefore, a thorough understanding of the M dwarf magnetic activity is required to investigate various physical processes associated with its generation. The magnetic activity in the M dwarf happens at various timescales ranging from a few seconds to several hours. While a good sample of M dwarfs has been studied to characterize the activity at the larger time scales through Hα variability, very few studies in the literature investigate Hα variability at shorter time scales of a few minutes. Thus, short-duration behaviour could not be probed, resulting in a gap in the systematic understanding of Hα variability on such timescales.

In our recent study, we have performed the low resolution (~5.7 Å) spectroscopic monitoring of 83 M dwarfs (M0-M6.5) to investigate the variability of Hα/Hβ emissions over the time-scales ranging from ~0.7 to 2.3 hours with a cadence of ~3-10 minutes. For this observing campaign, we used completely in-house developed Mount-Abu Faint Object Spectrograph and Camera-Pathfinder (MFOSC-P) instrument on the PRL 1.2 m telescope, Mt Abu. We have also used archival photometric light curves from TESS and Kepler/K2 missions to explore plausible systematics between rotation phases. 53 of the objects in our sample (~64%) show statistically significant short-term variability in Hα. This variability in 38 M dwarfs is most likely due to the flaring events. We also investigated the time scales of variability in the Hα EW time series using structure-function analysis (see figure). This variability time scale is found to be ~40-60 min for early M dwarfs (M0-M2) and longer than 60 min for mid-type M dwarfs (M3-M5). Such studies related to the time scales of the Hα/Hβ variations are of profound significance to understanding the underlying activity on the surface of the star.



The figure shows the time-varying spectra of an M dwarf observed with an in-house developed MFOSC-P instrument mounted on the PRL's 1.2m telescope at Mt. Abu (Left panel). The photometric light curve is shown in inset. Top-right panel shows the time series of equivalent-widths of H-alpha (red circles) and H-beta (black triangles) emission which show a variability pattern. Such time variability is quantified using the fractional structure function (bottom-right panel) and is of great interest for the studies of M dwarfs.

Source/Reference of the Work: https://doi.org/10.1093/mnras/stad2222

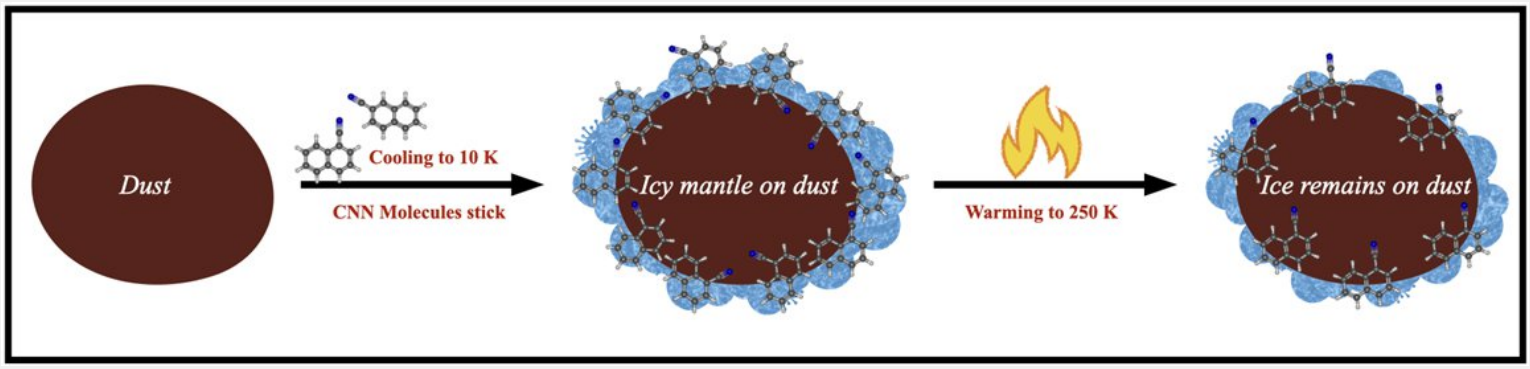
The durability and morphology of cyanonaphthalene ices in the ISM

(***R. Ramachandran***, *K.K. Rahul, J.K. Meka, S. Pavithraa, A. Roy, B.N. Rajasekhar, P. Janardhan, A. Bhardwaj, N.J. Mason, and B. Sivaraman)*

The Author

R. Ramachandran

Polycyclic aromatic hydrocarbons (PAHs) and their derivatives, like cationic, substituted and decorated PAH species, are suspected to be one of the contributors of the unidentified infrared (UIR) emission bands observed from galactic, extragalactic sources, planetary nebulae, interstellar medium (ISM) and other astronomical sources. However, identifying the exact forms of the PAH or the specific category of PAH responsible for the UIR bands remains a significant challenge in astronomy. In 2021, 1-cyanonaphthalene (1-C10H7CN, 1-CNN) and 2-cyanonaphthalene (2-C10H7CN, 2-CNN) were identified in TMC-1 with the 100 m Green Bank radio telescope using spectral matched filtering of the radio data. This recent identification of 1- and 2-CNN in the interstellar medium (ISM) requires laboratory support to understand the physico-chemical nature of these molecules when they are present as icy mantles on cold dust grains. Therefore we carried out the temperature-dependent infrared spectroscopic investigation of 1- and 2-CNN molecular ices under the interstellar conditions simulated in our laboratory using the in-house built state-of-the-art SALT setup. We also computed the IR spectra of the CNNs with their band strength (A), as these are available in the literature. When deposited at 7 K, the cyanonaphthalene ices were amorphous. Even upon warming to higher temperatures, cyanonaphthalene ices appear to remain amorphous until sublimation. We also observed that they both sublimate at very high temperatures (250 K - 265 K). This suggests the stability of the CNNs on ISM dust over an extensive temperature range which will hence influence the chemical complexity across the ISM.



Graphical representation of the CNN experiments and the significance that the CNN ice stays on the ISM dust analogues even at higher temperatures.

Source/Reference of the Work: https://doi.org/10.1007/s12039-023-02192-z

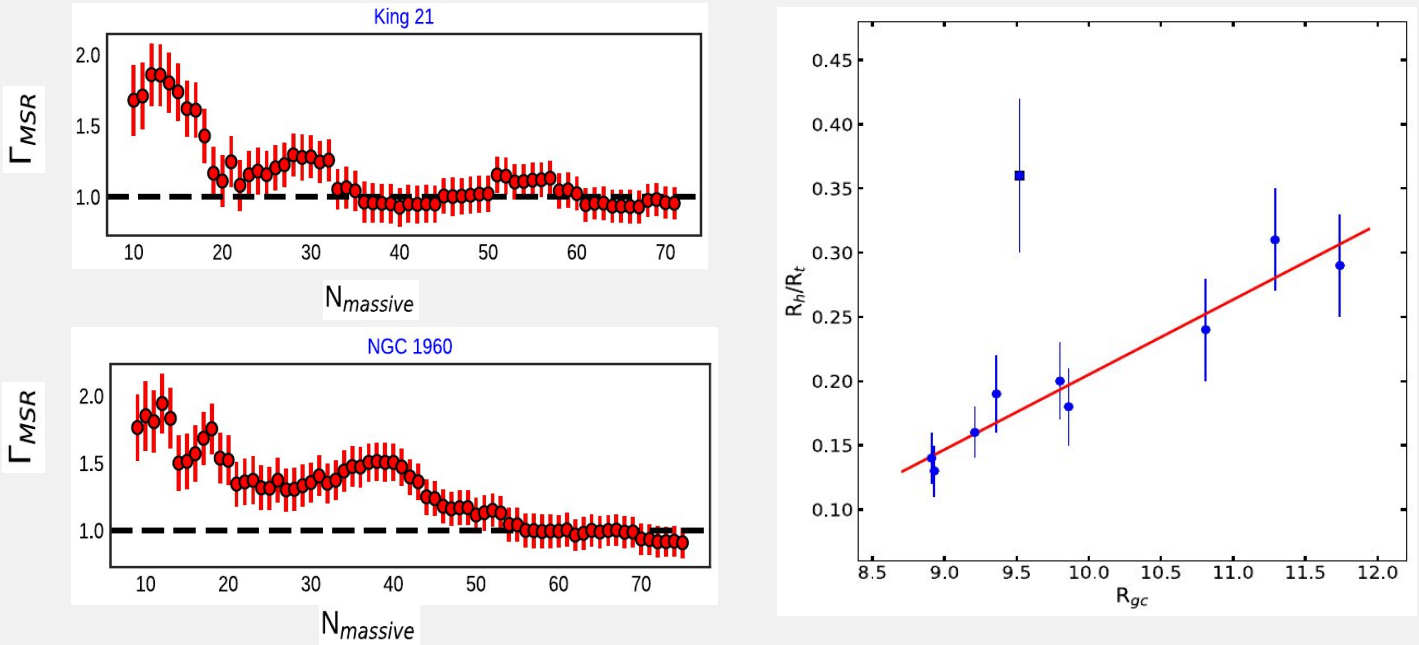
Statistical analysis of dynamical evolution of open clusters

(***J. Maurya***, *Y.C. Joshi, M.R. Samal, V. Rawat, and A.S. Gour)*

The Author

Jayanand Maurya

The majority of the stars, if not all, are considered to be formed in the clustered environment of molecular clouds. Those that survive cloud dispersal and remain gravitationally bound are seen as open clusters, with tens to thousands of member stars. As a cluster evolves, its evolution is governed by the interaction among the cluster members as well as the gravitational pull of the Galactic potential. In this work, we studied the dynamical evolution of ten open clusters. These clusters include both young and intermediate-age open clusters with ages ranging from 25 ± 19 Myr to 1.78 ± 0.20 Gyr. The total mass of these clusters ranges from 356.18 ± 142.90 to 1811.75 ± 901.03 M(Solar Mass). The Galactocentric distances to the clusters are in the range of 8.91 ± 0.02–11.74 ± 0.18 kpc. The study is based on the ground-based UBVRI data supplemented by the astrometric data from the Gaia archive. The mass segregation in these clusters was quantified by mass segregation ratios (MSR) calculated from the mean edge length obtained through the minimum spanning tree of the member stars for these clusters. The clusters NGC 2360, NGC 1960, IC 1442, King 21 and SAI 35 have MSR to be 1.65 ± 0.18, 1.94 ± 0.22, 2.21 ± 0.20, 1.84 ± 0.23 and 1.96 ± 0.25, respectively, which indicate moderate mass segregation in these clusters. The remaining five clusters are found to exhibit weak or no mass segregation. We used the ratio of half mass radius to the tidal radius, i.e., R_h /R_t to investigate the effect of the tidal interactions on the cluster structure and dynamics. The ratios of half mass radii to tidal radii are found to be positively correlated with the Galactocentric distances with a linear slope of 0.06±0.01 having linear regression coefficient r-square = 0.93 for the clusters. Our analyses suggest that the Galactic potential has played a significant role in the evolution of these clusters.



Left panel shows the mass segregation ratio (Γ_{MSR}) as a function of the Nth massive star ($N_{massive}$) for the clusters King 21 and NGC 1960, where Γ_{MSR} stands for the ratio of the mean edge length of the N most massive stars to the mean edge length of N random stars in these clusters. Right panel shows how the ratio of half-mass radius (R_h) to tidal radius (R_t) of the studied clusters changes with their distance from the Galactic center (R_{gc}). The point shown by the square is an outlier.

Source/Reference of the Work: https://doi.org/10.1007/s12036-023-09959-3

Coronal Properties of Low-Accreting AGNs using Swift, XMM-Newton and NuSTAR Observations

*(A. Jana, A. Chatterjee, H.K. Chang, **P. Nandi**, K. Rubinur, N. Kumari, S. Naik, S. Safi-Harb, and C. Ricci)*

The Author

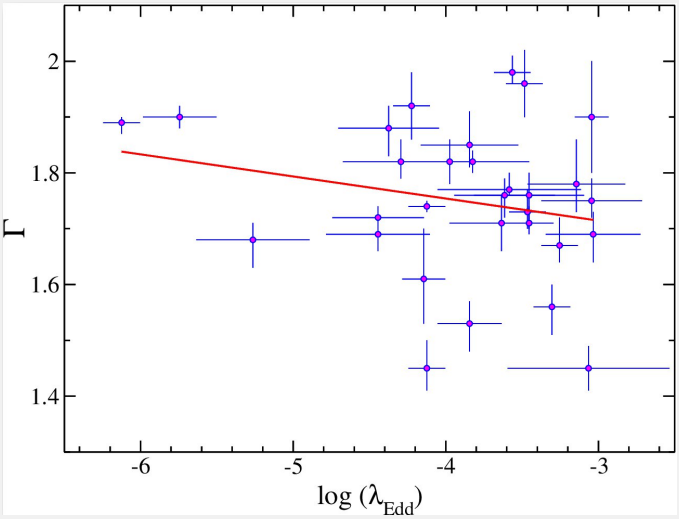
Prantik Nandi

Active Galactic Nucleus (AGN) is a compact region at the center of a galaxy where a supermassive black hole accretes mass and emits intense radiation across multiple wavelengths. A subclass of AGNs, known as low-luminosity AGNs (LLAGNs), has bolometric luminosities $L_{bol} < 10^{44}$ ergs/s. Recent studies suggest the mass-normalized accretion rate drives circumnuclear gas evolution. In this context, low-accreting AGNs (LAC-AGNs; Eddington ratio $\lambda_{Edd}=L_{bol}/L_{Edd} < 10^{-3}$, where L_{Edd} is Eddington luminosity) exhibit distinct accretion mechanisms from high-accreting AGNs ($\lambda_{Edd}=L_{bol}/L_{Edd} > 10^{-3}$).

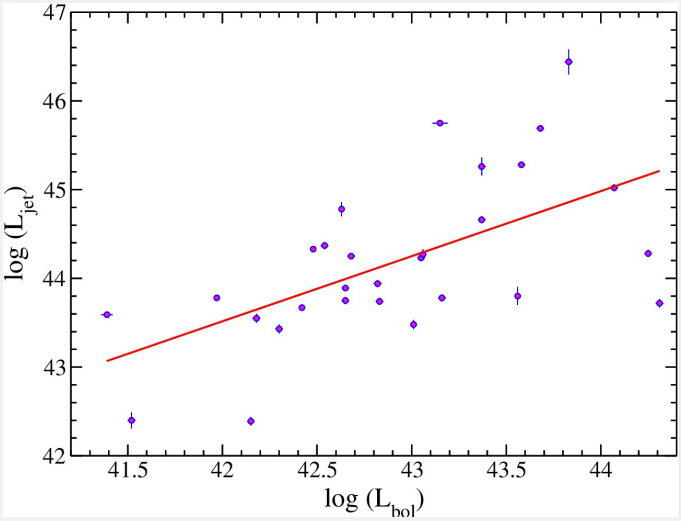
In this study, we conducted a comprehensive study of the broadband X-ray spectra emitted by a selection of low-accreting Active Galactic Nuclei (AGNs) identified by the Swift/BAT. Our analysis employed observations from XMM-Newton, Swift, and NuSTAR across an energy range of 0.5-150.0 keV. The sample comprises 30 AGNs with Eddington ratios (λ_{Edd}) below 10^{-3}. Spectral modeling unveiled coronal parameters: photon index, hot electron temperature, cutoff energy, and optical depth. Interestingly, we found a correlation between hot electron temperature and cutoff energy, similar to high-accretion scenarios.

We explored the interplay between Eddington ratio and photon index (see Figure 1), revealing an unexpected lack of correlation, highlighting complexity in emission mechanisms. Additionally, jet luminosity, calculated from radio flux, displayed a power-law relation $L_{jet} \propto L_{bol}^{0.7}$ (see Figure 2), aligning with the radio-X-ray correlation.

In summary, our study enhances understanding of spectral intricacies in low-accreting AGNs and uncovers unexpected parallels across diverse accretion contexts. These findings contribute to comprehending the intricate physical processes governing AGN emissions over a range of accretion rates.



The Γ is plotted as a function of the λ_{Edd}. The red line represents the best-fit of the linear regression analysis.



Variation of the L_{jet} as a function of λ_{Edd}. The solid red line represents the best fit with linear regression. The slope of the fit is 0.68 ± 0.12.

Source/Reference of the Work: https://doi.org/10.1093/mnras/stad2140

Demonstration on the Integration of GEM-COINS System on 13th July, 2023 (Computer Networking & Information Technology Division)

There was a guidelines by Ministry of Commerce & Industry, Govt. of India to procure material via GeM Portal. To maintain the consistency with our ISRO software, i.e. Cowaa/COINS, Purchase and Stores users has release and maintain Purchase related data in Cowaa/COINS too.

ISRO has developed IGIS (ISRO-GeM Interface System) Server. IGIS Server act as a bridge between COINS & GeM Portal and helps to import POs, Invoices, CRAC Bills, etc. released on GeM into COINS. This will reduce redundant work at Purchase and Store Section, ensure data integrity and enhance users efficiency & productivity.

A meeting on IGIS Server integration and demonstration was held on July 13, 2023 in CNIT Committee room. The purpose of the meeting was to make aware concerned Cowaa/COINS users from Purchase and Stores about the IGIS.

Glimpses from the Event

Two Days Training Programme on Gateway Level Perimeter Network Security device of PRL
Computer Networking and Information Technology (CNIT) Division

PRL Computer Networking and Information Technology (CNIT) Division arranged Two days training session on Gateway Level Perimeter Network Security device/appliance of PRL for CNIT staff members on 18th & 19th July 2023 at Navrangpura Campus. The main objective of the programme was to familiarize all CNIT staff members with the newly installed Gateway Level Perimeter Network Security architecture, management and monitoring aspects for day-to-day activities related to project.

Considering CNIT team's over all work responsibility, the training programme was arranged in two half-day morning sessions. The newly implemented BGP (Border Gateway Protocol) architecture at perimeter level, features of open-source pfSense firewall appliance and various basic concepts/ terminologies of firewall security architecture and rules implemented at PRL were covered during the training program. Moreover Intrusion Detection System (IDS) / Intrusion Prevention System (IPS) based features implemented through 3rd party commercial services like ET Pro rules & Snort rules were discussed & explained in detail, these rules database provides defense against Emerging Threats.

CNIT staff interacting and attending the training program

During the training recently implemented Site-to-Site Virtual Private Network (VPN) Tunnel between Navrangpura Campus to USO campus and Mt. Abu Campus using different set of pfSense hardware firewalls was also explained and discussed. The training program employed a combination of talks, live demonstrations, physical level cables/ports identification and interactive discussions to ensure active learning and engagement.

All CNIT staff members have actively participated in the training and appreciated the training program.

CNIT team thank Director, PRL, Registrar, PRL, Dean, PRL, Chair, Computer Committee and IT Security Committee for their continuous support & motivation.

CNIT staff interacting and attending the training program

संसदीय राजभाषा समिति की दूसरी उप-समिति द्वारा भौतिक अनुसंधान प्रयोगशाला (पीआरएल), अहमदाबाद का निरीक्षण

संसदीय राजभाषा समिति की दूसरी उप-समिति द्वारा भौतिक अनुसंधान प्रयोगशाला (पीआरएल), अहमदाबाद का निरीक्षण राजकोट, गुजरात में सोमवार दिनांक 10 जुलाई, 2023 को किया गया। माननीय समिति ने कार्यालय में चल रहे हिंदी के कार्यान्वयन की समीक्षा की एवं सुझाव प्रेषित किए। माननीया सांसद प्रो. रीता बहुगुणा जोशी की अध्यक्षता में यह निरीक्षण किया गया। भौतिक अनुसंधान प्रयोगशाला के निदेशक प्रो. अनिल भारद्वाज, प्रो. आर.डी. देशपांडे, वरिष्ठ प्रोफेसर एवं रजिस्ट्रार, प्रो. सोम कुमार शर्मा, प्रोफेसर, श्री प्रदीप कुमार शर्मा, वरिष्ठ प्रशासनिक अधिकारी, श्रीमती रुमकी दत्ता, सहायक निदेशक (रा.भा.) और अंतरिक्ष विभाग की ओर से श्री लोचन सेहरा, संयुक्त सचिव, इन-स्पेस एवं डॉ. शंकर कुमार, संयुक्त निदेशक (रा.भा.) उपस्थित रहे। निरीक्षण के दौरान संसदीय समिति द्वारा भौतिक अनुसंधान प्रयोगशाला में किए जा रहे हिंदी कार्यान्वयन के कार्यों की सराहना की गई एवं ध्यान देने योग्य बातों पर भी चर्चा की गई। यह निरीक्षण सफलतापूर्वक पूर्ण हुआ। निदेशक महोदय ने भौतिक अनुसंधान प्रयोगशाला का पारंपरिक स्टोल ओढ़ाकर समिति का सम्मान किया एवं गृह-पत्रिका "विक्रम" की प्रति भेंट की। इस निरीक्षण के समापन पर रजिस्ट्रार, प्रो. आर.डी. देशपांडे द्वारा माननीय समिति का आभार ज्ञापन किया गया।

निरीक्षण कार्यक्रम की झलक: संसदीय राजभाषा समिति की दूसरी उप-समिति द्वारा राजकोट, गुजरात में सोमवार दिनांक 10 जुलाई, 2023 को भौतिक अनुसंधान प्रयोगशाला (पीआरएल), अहमदाबाद का निरीक्षण

PRL Ka Amrut Vyakhyaan

PKAV-82

"Human Impact on Global Climate Change Over the Past Two Centuries: Use of Isotope-Tracing Techniques"

Abstract

Prof. Mark Baskaran is an internationally recognized scientist in the field of Environmental Science and Geochemistry whose research focuses on applications of isotopes as tracers and chronometers in environmental subsystems. In this 82nd PRL ka Amrut Vyakhyaan held on 19 July 2023, the various aspects of human impact on global climate change over the past two centuries were presented in great details. Prof. Mark Baskaran mentioned that an incredible growth of population, from 1.5 billion in the year 1900 to 7.9 billion today has led to an increase in energy consumption by more than 1000% over ~70 years to power the development. Never in the history of the Earth has such a drastic increase in the atmospheric carbon dioxide (a greenhouse gas) took place; which is attributed mainly to the energy extraction from non-renewable resources (e.g., fossil fuel) contributing ~85% of total energy consumption. The 'science of the changing environment' is at the forefront of human endeavor and a significant (and increasing) fraction of the global GDP is currently being spent on addressing this science (e.g., increasing spatial extent of harmful algal blooms, ocean acidification, ever increasing number of micro-plastics in fresh and saltwater systems, weather-related catastrophic events, etc.). As an expert working in the field of isotopes of key chemical elements, Prof. Baskaran highlighted its utilization to identify and quantify recent environmental changes. In this PRL ka Amrut Vyakhyaan, a set of case studies, illustrating global environmental changes in different regions of global oceans were also discussed.

Available Online at: https://www.youtube.com/live/b4uPcDHRTJw?feature=share

पीआरएल अमृत राजभाषा व्याख्यान (पर्व)

PRL AMRUT RAJBHASHA VYAKHYAAN (PARV)

पीआरएल में दैनंदिन कार्यों में राजभाषा के प्रयोग को बढ़ावा देने के लिए वर्ष 2023-24 में राजभाषा हिंदी में मासिक व्याख्यानों की एक नई श्रृंखला "पीआरएल अमृत राजभाषा व्याख्यान (PARV)" शुरू की गई है। इस श्रृंखला के अंतर्गत, 26 जुलाई, 2023 को दूसरा ज्ञानवर्धक व्याख्यान हुआ। विशिष्ट वक्ता, डॉ. हर्षिल मेहता, एक अनुभवी चिकित्सक हैं, जो स्वास्थ्य देखभाल एवं परामर्श, नैदानिक अनुसंधान, शिक्षा, और आपातकालीन चिकित्सा के क्षेत्र में अपनी उपलब्धियों के लिए प्रसिद्ध हैं।

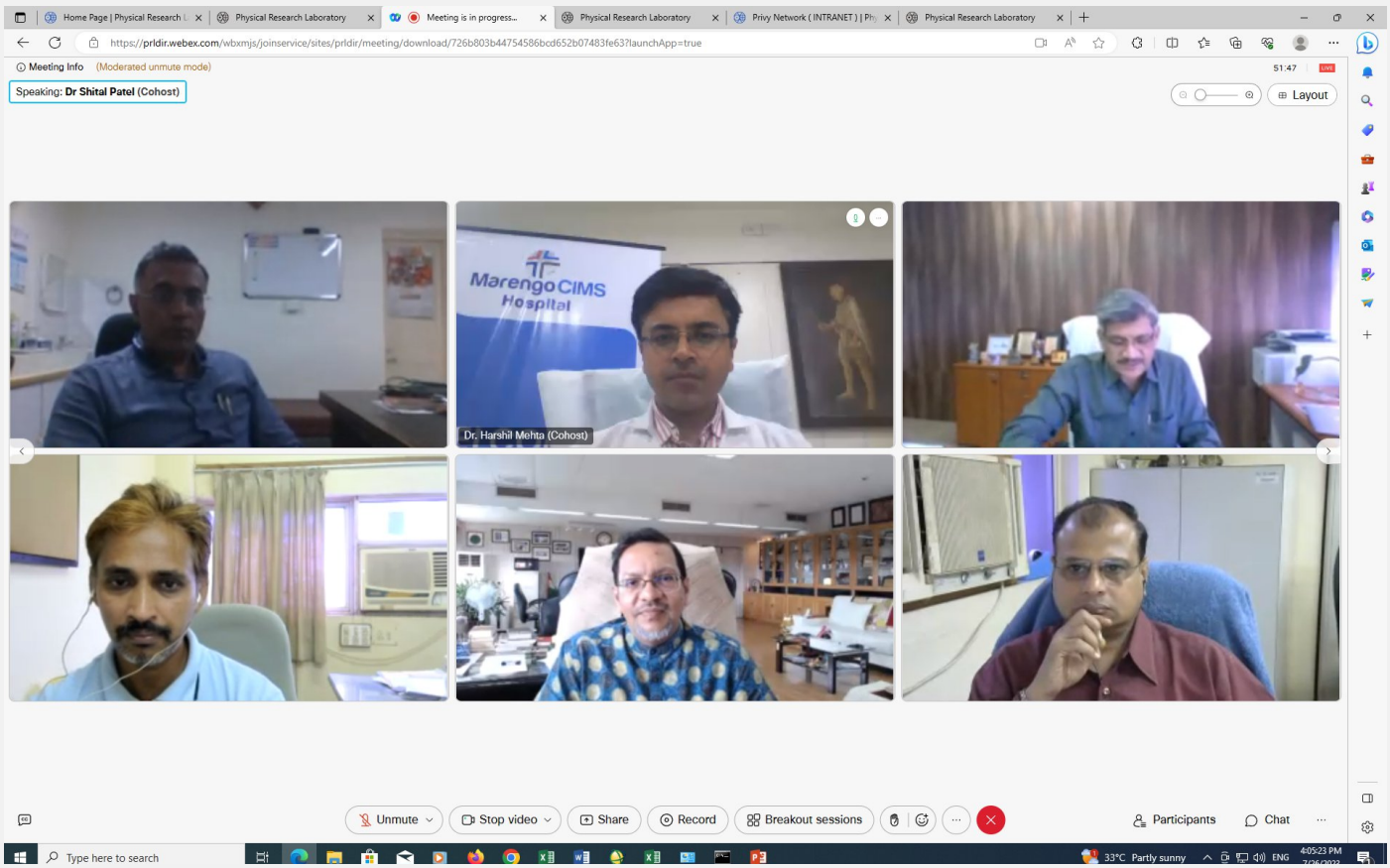
"तनाव प्रबंधन" के रोचक एवं गंभीर विषय पर प्रकाश डालते हुए डॉ. हर्षिल मेहता ने आज की जटिल दुनिया में तनाव को प्रभावी ढंग से प्रबंधित करने के गहन महत्व पर प्रकाश डाला। उन्होंने सूक्ष्मता से बताया कि कई तकनीकों और नीतियों को अपनाकर, व्यक्ति सक्रिय रूप से अपने शारीरिक, मानसिक और भावनात्मक कल्याण पर तनाव के प्रतिकूल प्रभावों को कम कर सकते हैं। डॉ. मेहता ने बताया कि तनाव प्रबंधन को प्राथमिकता देने से सहनशीलता विकसित करने में मदद मिलती है, चुनौतियों का सामना करने की क्षमता बढ़ती है और व्यक्तियों को स्वस्थ, अधिक समृद्ध जीवन जीने का अधिकार मिलता है।

इस ज्ञानवर्धक व्याख्यान के बाद, एक आकर्षक प्रश्नोत्तर सत्र शुरू हुआ, जिससे प्रतिभागियों को विषय वस्तु को गहराई से समझने और व्यक्तिगत अंतर्दृष्टि प्राप्त करने का मौका मिला।

To promote the use of official language in day-to-day work in PRL, a new series of monthly lectures in official language Hindi in the year 2023-24 was initiated as "PRL Amrut Rajbhasha Vyakhyan (PARV)". As part of this series, a 2nd enlightening lecture took place on 26th of July, 2023. The distinguished speaker, Dr. Harshil Mehta, boasts a distinguished background as a seasoned medical practitioner, renowned for his accomplishments in the realms of healthcare, consulting, clinical research, academia, and emergency medicine.

Delving into the captivating topic of "Stress Management", Dr. Harshil Mehta elucidated the profound significance of effectively managing stress in today's intricate world. He skilfully conveyed that by embracing a spectrum of techniques and strategies, individuals can actively mitigate the adverse impacts of stress on their physical, mental, and emotional well-being. Dr. Mehta went on to expound that making stress management a priority facilitates the cultivation of resilience, enhances the capacity to confront challenges, and empowers individuals to lead healthier, more enriching lives.

Following this insightful lecture, an engaging Question and Answer session ensued, allowing participants to delve deeper into the subject matter and glean personalized insights.



Glimpses from the Event

Available online at: https://www.youtube.com/live/yupfmTd4rxE?feature=share

My personal reminiscences of Professor U.R. Rao: Tribute to a legend

(Prof. Ashok Ambastha)

I would recall here about my first encounter with Professor U.R. Rao that goes as far back as in the year 1975. It was near our students' hostel courtyard adjoining the P.R.L. guest house. Some of us, freshly joined PR. that year as visiting members (as PRL research scholar were referred to at that time), had enacted a skit at PRL Staff Club. It was entitled "Naarad ki prithvi yaatra", directed by Prof. Ram K. Varma, soon to be my PhD supervisor. This skit was based on Naarad's rendezvous with a strange new object in the sky, while Naarad was making one of those reconnaissance trips to the Earth. One of my batch mates, Shyam Lal, had very ingeniously built a scaled down model of Aryabhata, fitted with blinking lights, probes, solar panels, and all such gimmicks meant to go with this skit. This model was made to slide from one end to the other across our make-shift stage. It was pushed and glided slowly along a wire stretched across the guesthouse lawns for the huge amusement and applause of our viewers. Naarad (enacted by me) was taken aback seeing this strange object, and looked at it with bewilderment. There were some exchanges of hilarious dialogs between him and Aryabhata, impersonated for voice by one of my batch mates.

Aryabhata was launched only earlier that year in April 1975, under the leadership of Prof. Rao, from a cosmodrome in the then USSR. Actually, in my opinion, this first Indian satellite was also India's first astronomy satellite, and not ASTROSAT launched much later in 2015. This is because Aryabhata primarily conducted experiments in X-ray astronomy, aeronomy and solar physics. After the successful Aryabhata mission, Prof. Rao was already recognized as a hero not only at P.R.L., but by the entire nation. Needless to say, our skit was well appreciated by the audience, comprising of students, faculty members, staff and their families living in PRL quarters. Someone perhaps had already conveyed about our skit, so when he came visiting PRL the next time; naturally he was looking for us, the `culprits'. Fortunately, it turned out that he too was amused, and had a characteristic hearty laugh.

During my doctoral and post-doctoral terms at PRL in the period of 1975-1983, I had the privilege of meeting and interacting with Prof. Rao at PRL, or in the quarters, on numerous occasions. In spite of his very busy schedule those days as the Director of Indian Satellite project at Bangalore (recently christened as U.R. Rao Satellite Centre), he visited PRL frequently. Some of his students, and my seniors, Ashok Jain, A.G. Ananth, and S. M. Bhandari, were in the final stages of finishing their thesis work. I still carry memories of those meetings, and attending to his many talks in PRL. Later, many more such occasions came my way, on both academic and personal levels, of meeting him in Ahmedabad, and elsewhere in India.

I moved to Udaipur, in 1983 to join USO under its founder director, Dr. Arvind Bhatnagar, as the only scientist approved by DOS at the time of USO's take over. USO had a very slow growth since its foundation on 20th September 1975, as those were the days of very modest resources at its disposal. The scientific activities of USO were just barely sustained by project based funding received from CSIR-SERC, and support from fellow solar astronomers from Australia and USA Vedhshala Trust, Ahmedabad, had been providing financial support towards the salaries, however, this gradually dried up with time. In December 1981, USO was finally taken over by DOS after a site visit of Prof. Satish Dhawan, the then Chairman, and Mr. T. N. Seshan, Additional Chairman of DOS After the takeover of USO as a unit of DOS, it was placed under administrative control of PRL.

Prof. Rao took enormous interest in the growth and development of USO., when he took over as the Chairman, DOS. in 1985. Although he had interest in nearly anything and everything involving physics, in general, from his early Ph D days at PRL, he had a particular penchant for solar physics, besides cosmic rays, his PhD topic. In fact, he taught cosmic rays and solar physics at MIT, USA. His interest in USO increased when he took charge as the Chairman, PRL Council of Management in 1988. USO was indeed privileged to receive his personal interest in its growth and scientific activities. He was instrumental to facilitate the construction of USO's first solar tower in the island (1986-88), its participation in the Global Oscillation Network Group's (GONG) site survey program (1986-92), and thereafter, as one of the final six-sites of GONG (1995-onwards), solar eclipse expeditions, and several other such academic endeavours, and later, in MAST during 2000-2015.

Prof. U.R. Rao, with Dr. Arvind Bhatnagar, laying the foundation stone for USO's main campus building (12th March 1992)

Since its inception, USO had been operating from a very modest rental building at 11, Vidya Marg, Dewali village, Udaipur, located near lake Fatehsagar. It was essentially a residential house, and was inadequate for catering to USO's basic logistic requirements, and use as a proper, modern laboratory. He appreciated the need for building a suitable office campus at the 10-acre land that was acquired by USO in 1986, near the north-western shore of the lake. He visited USO, Udaipur for laying the foundation stone of the main building on 12th March 1992, and then again, on the completion of the building to formally inaugurate it on 3rd September 1996.

At the island observatory, with the full disk solar telescope (small dome) and main dome in the background in 1992. Prof. U.R. Rao, Prof. R.K. Varma (Director, PRL), Dr. K. Kasturirangan, and others are seen with USO staff.

Prof. U.R. Rao inaugurating the new office building of USO (3rd September 1996).

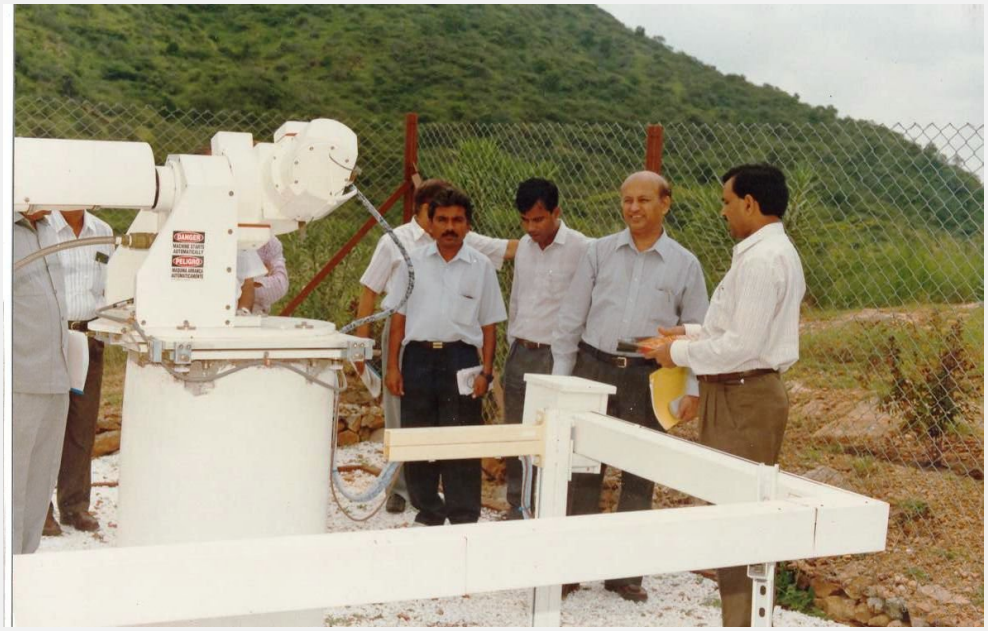
The formal inaugural function of the new office building of USO (3rd September 1996). Prof. S.P. Pandya (Former Director, PRL), Shukdev Vyas of Vedhshala Trust, Prof. R.K. Rai (Former Vice-Chancellor, Sukhadia University, Udaipur, Prof. U.R. Rao, Prof. G.S. Agarwal (Director, PRL),Dr. A.K. Singhvi (Collector, Udaipur), Dr. Arvind Bhatnagar and Dr. Ashok Ambastha.

Prof. Rao took keen interest in the development of the residential colony of USO on a land acquired along Bari Road, nearly 3 km away from the main office of USO. He visited the site personally during the construction, and had intensive discussions with the engineers involved in the work.

Prof. U.R. Rao and Prof. G.S. Agarwal at the residential campus of USO to discuss the site plan with the engineers. Also seen are M.R.G. Murthy, Y.M. Trivedi, Dr. P. Venkatakrishnan and Dr. Ashok Ambastha among others.

I would like to share an interesting anecdote here. Since early 1990, we were involved in constructing a solar video-magnetograph at USO; acquiring components from collaborators, and purchasing various equipments including optics, electronics, and a suitable workstation capable of carrying out real time operations involving fast cadence solar digital imaging and processing. Prof. Rao asked us to give a presentation about it at PRL. He instructed us to also report about the progress made in the international GONG. project, which had just become operational in USO. in 1995. While listening intently to our presentation, he suddenly interjected curtly, "Why make so much fuss about measuring Sun's magnetic fields? Why don't you people work on Jupiter's magnetic fields that is such an interesting and hot topic nowadays!". This came as a rude jolt to us then, but it turned out that his idea was simply to provoke and test our motivation about the instrument and its potential. He desired us to convince and justify as to why this work was so important for solar physics in India. (Incidentally, the video magnetograph was later completed as part of the thesis of Dr. Shibu Mathew. It was to be the first operational solar magnetograph facility in India.). In any case, Jupiter's magnetic fields had been attracting a lot of interest at that time and even now. As recently as in 2016, Juno mission made a polar orbit around the Jovian planet, and observed its magnetic field in great details. It turns out that no other planet in our solar system has magnetic field structures like Jupiter's. It has been now observed that Jupiter has a peculiar third magnetic pole near its equator (Nature, 7 October 2018).

As we went on to report about the GONG instrument installed and made operational a year ago at USO, another direct and blunt comment came our way: "I see that you are merely serving as a Data Acquisition Centre for GONG. Why are you not using GONG data for your own scientific research? ". Actually USO then had very meagre computational resources those days. We were lacking in a suitable computational platform, SUN workstations under a specific operating system that was needed for installing the GONG data reduction and analysis software. Of course, this query from him eventually led to the provision of the required funds on an urgent basis, and subsequently, USO could begin earnestly contributing to the new emerging, frontier field of helioseismology.



Prof. U.R. Rao at the USO-GONG instrument site along with S. C. Tripathy, Debi Prasad, S.K. Gupta, Prof. G.S. Agarwal and others.

Prof. U. R. Rao with P Venkatakrishnan, Prof. G. S. Agarwal, Ashok Ambastha, and Dr. Arvind Bhatnagar at the island observatory.

Prof. Rao visited Udaipur on many occasions, gave public lectures, and interacted with USO faculty. He constantly prodded and motivated us to engage on frontier areas of solar physics, and deliver results. He once came to Udaipur on his capacity as the Chairman of Prasaar Bharati; one of the several hats he wore at that time. Even in the midst of his busy schedule of engagements elsewhere in Udaipur, he found time to meet USO faculty as he desired to be apprised of any new developments. In the meetings held in other institutions at Udaipur, he referred us fondly as 'my people'.

One of the problems in solar physics, in which we developed interest, was related with Professor Rao's important work carried out during the total solar eclipse of 16 February 1980 in India. During this eclipse, he had carried out an experiment to search for the presence or absence of a circumsolar dust ring around the Sun at 4 solar radii using 2.2 microns radiation. It turned out that he did not detect a bump which would confirm its presence (U.R. Rao et al., Nature, vol. 289, 779-780, 1981). There had been many contradictory reports about existence of such a ring around the Sun forming based on the same process which works for rings around some major planets of our solar system.

We too decided to conduct an experiment while observing the great Indian eclipse of 24th October 1995 to look for it.

At this time, the Sun was at the minimum activity phase of Cycle 22. Therefore, it was expected that if such a ring does indeed exist, we should be able to observe it. We attempted to observe signature of the ring in optical polarization and in near-IR, but again, no conclusive evidence could be made (D.P. Choudhary and A. Ambastha, Kodai. Obs. Bull. 13, 17-23, 1997). When Prof. Rao visited Udaipur, we discussed our results with him. He was very interested to know the details of our experiment, and encouraged us to undertake more such eclipse expeditions. (More recently, observational evidences for a ring near the orbit of Venus have come from various sources, including from NASA's STEREO which was used to map the dust ring: Jones et al. Science, vol. 342, issue 6161, pp 960-963, 2013).

Dr. John Leibacher (PI, GONG), Prof. U.R. Rao, Dr. Arvind Bhatnagar and Prof. G.S. Agarwal at USO Silver Jubilee Workshop 2001.

Prof. Rao always insisted in taking up challenging projects without fear, or worrying about budgetary constraints. When in 2000, USO started planning to have a modern solar telescope, with larger aperture than so far available in India; he encouraged us to consider some innovative methods. This included a "multi-aperture" solar telescope (MAST) approach that involved major design challenges in optics and related technology. Although this is possible in principle, as demonstrated by aperture synthesis technique being successfully used in long baseline radio interferometry, it is extremely complex and difficult to achieve for the much smaller wavelengths involved in optical telescopes. But it did not deter him from considering this challenging approach. At the same time, he was amenable to accept practical constraints. Various options were discussed in detail, and feedbacks were received from experts in optics, and solar physics during USO's Silver Jubilee Meeting in 2001. Prof. Rao attended this meeting and participated in all the deliberations. Over the year, however, the idea transformed from 'Multi-Aperture' to a more feasible 'Meter Aperture' and finally to 'Multi-Application' Solar Telescope, when the optimization of site characteristics of Udaipur led to the realization that one meter aperture would not provide any significant advantage over a 50-cm aperture.

Prof. Rao specially came to USO to observe the rare event of Venus transit of Sun in June 2004 (Incidentally, the next pair of transits of Venus will take place after a century from now, occurring only in December 2117, and then in December 2125).

His enthusiasm and excitement during that rare event was extremely motivating for the large groups of local students, amateur astronomers from Mumbai and Delhi, and a team of 72 school children who had specially come to Udaipur all the way from the seven states of the north-east to witness this transit.

Prof. U.R. Rao at island observatory during Venus Transit-2004 event with amateur astronomers from Delhi and Mumbai. Also seen are Prof. J.N. Goswami, P. Venkatakrishnan, Y.M. Trivedi, and A. Ambastha.

Another incident about his enthusiasm and eagerness for adopting challenging and innovative approach that comes to my mind is his idea of placing the proposed Aditya mission of ISRO at the Lagrangian L1 position, instead of a lower Earth orbit that was planned initially. The L1 point lies on the direct line between the Earth and the Sun, where the gravitational forces between these two celestial bodies nearly balance out. This point is located around 1.5 million km away from the Earth. Placing at this ideal location in space would allow Aditya-L1 mission to have the same orbital period as that of the Earth's, always looking at the Sun. Such an attempt has not been made so far by ISRO, hence it would indeed be a new challenging effort (As of now, Aditya-L1 is expected to be launched in August 2023). It would also have a definite advantage of allowing the space-borne solar observatory a continuous coverage of the Sun and its corona.

He was dynamic, driving force behind PRL's organizing of the "International Conference on Exploration and Utilization Meeting of the Moon" at Udaipur in November 2004 that was inaugurated by Dr. APJ Abdul Kalam, the then President of India. This meeting was attended by a large number of scientists from India and abroad, from many space agencies and institutions. It would not be an exaggeration if it is said here that this meeting eventually culminated in ISRO's Chandrayaan project.

Another major scientific meeting that he very energetically and enthusiastically organized was COSPAR at Mysuru in 2012.

This meeting was attended by more than 1800 space scientists and astronomers from all over the world. Many of us in USO and PRL were witness to his enormous dynamism and all round efforts in making these major scientific meetings the great success they turned out.

During the nearly 15 years long period of evolution and completion of MAST project, Prof. Rao constantly remained in contact with USO scientists, and extended support and guidance while keeping close watch on its progress. He came in August 2015 to inaugurate MAST despite his frail health, and the fact that he had considerably reduced undertaking such trips due to health issues.Regrettably this was to be his last visit to Udaipur.

Throughout his illustrious life, Prof. Rao continued to inspire many generations of young scientists not only in PRL, but all over India. He was always looked upon as a source of enormous inspiration, motivation and excitement. With his untiring efforts, he played a big role in making ISRO what it is today; a household name synonymous with success, and an institution on which Indians can genuinely feel proud. It is difficult to fill the void created by his departure, particularly as he was so closely associated with PRL for period spanning over several decades, through its many ups and downs. He will always be remembered for providing very dynamic leadership and patronage to PRL and ISRO that will be sorely missed in the years to come.

PRL Monthly Publications Digest (July 2023)

Astronomy & Astrophysics Division [3]

1. A. Jana, A. Chatterjee, H.K. Chang, P. Nandi, K. Rubinur, N. Kumari, S. , S. Safi - Harb, C. Ricci, 2023, Coronal Properties of Low-Accreting AGNs using Swift, XMM-Newton and NuSTAR Observations, Monthly Notices of the Royal Astronomical Society, 524, 4670 - 4687, Date of Publication: 31/07/2023

2. V. Kumar, A. S. Rajpurohit, M. Srivastava, J.G. Fernández-Trincado, A.B.A. Queiroz, 2023, Exploring the short-term variability of Hα and Hβ emissions in a sample of M dwarfs, Monthly Notices of the Royal Astronomical Society, Date of Publication: 26/07/2023

3. J. Maurya, Y. C. Joshi, M. R. Samal, V. Rawat and A. S. Gour , 2023, Statistical analysis of dynamical evolution of open clusters, Journal of Astrophysics and Astronomy, Date of Publication: 10/07/2023

Atomic Molecular and Optical Physics Division [2]

1. S. Barik, N. R. Behera, S. Dutta, R. K. Kushawaha, Y. Sajeev, O. R. Ramabhadran, G. Aravind, 2023, Molecular growth of PANH via intermolecular Coulombic decay, SCIENCE ADVANCES, Date of Publication: 26/07/2023

2. S.V. Singh, V. Jayaram, J.K. Meka, V. Thiruvenkatam, S. Vijayan, A. Bhardwaj, M. J. Burchell, N. J. Mason and B. Sivaraman , 2023, Extraterrestrial Impacts Creating Architectures for Life, Journal of the Indian Institute of Science, Date of Publication: 04/07/2023

Geosciences Division [3]

1. N. Sharma, M.C. Liang, A.H. Laskar, K.F. Huang, N.S. Maurya, V. Singh, R. Ranjan, A. S. Maurya, 2023, Basin-Scale Geochemical Assessment of Water Quality in the Ganges River during the Dry Season, Water, Date of Publication: 03/07/2023

2. S.P. Sati, M. Asim, Y.P. Sundriyal, N. Rana, V. Bahuguna, S. Sharma, 2023, Unstable slopes and threatened livelihoods of the historical Joshimath town, Uttarakhand Himalaya, India., Current Science, Date of Publication: 17/07/2023

3. S. Chakra, A. Ganguly, H. Oza, V. Padhya, A. Pandey, R.D. Deshpande, 2023, Multidecadal summer monsoon rainfall trend reversals in South Peninsular India: A new approach to examining long-term rainfall dataset, Journal of Hydrology, Date of Publication: 25/07/2023

Space & Atmospheric Sciences Division [1]

1. A.Bhardwaj, A. Gupta, Q. Ahmed, A. Singh, S., S. Sarkhel, M.V. S. Krishna, D. Pallamraju, T. Pant, and A.K. Upadhayaya, 2023, Signature of Y-forking in Ionogram traces observed at low-mid latitude Indian station, New Delhi during earthquake events of 2020: Ionosonde Observations, Frontiers in Astronomy and Space Sciences, Date of Publication: 18/07/2023

Theoretical Physics Division [1]

1. N. Mahajan, 2023, ALPs and heavy hadron chiral perturbation theory, Phys. Rev. D 108, 014016 (2023), Date of Publication: 19/07/2023

Udaipur Solar Observatory [1]

1. P.K. Mitra, A.M. Veronig and B. Joshi, 2023, Circular ribbon flare triggered from an incomplete fan-spine configuration, Astronomy & Astrophysics, Date of Publication: 10/07/2023

Awards and Honours

1. ***Mr. Santunu Kumar Panda***, SRF, Atomic, Molecular and Optical Physics Division of PRL has received ***The Best Poster Award*** in the ***"7th International Conference on Luminescence and its Applications (ICLA-2023)"*** organised by Luminescence Society of India and CSIR-Indian Institute of Chemical Technology, held at Hyderabad during 03-06 July 2023. The title of his poster was "Understanding the change in sensitivity of quartz by annealing and diffusion of water at high temperature" authored by Santunu Panda, Kartika Goswami and Naveen Chauhan.

2. ***Dr. K. Venkatesh***, Assistant Professor, Space and Atmospheric Sciences Division of PRL has been elected ***as the Chair for the Working Group II-E (Ionospheric irregularities, Field and waves) of the International Association of Geomagnetism and Aeronomy (IAGA)***, for the duration of (2023-2027) in the ***28th General Assembly of IUGG***, held at Berlin, Germany during 12 to 18 July 2023.

3. Mr. Trinesh Sana, SRF, Planetary Sciences Division of PRL has received The Best Oral Presentation Award in the"9th Plasma Scholar Colloquium (PSC-2023)" organised by Plasma Science Society of India (PSSI) and Department of Physics, IIT Kanpur held at IIT Kanpur during 20-21 July 2023.The title of his talk was "Electrical Plasma Environment Around Chandrayaan 3 Landing Site" authored by Trinesh Sana and S.K.Mishra

4. ***Mr. Vineet Rawat***, SRF, Atronomy and Astrophysics Division of PRL has received ***The Best Poster Award*** in the ***"Research Showcase Event, 2023 Cycle"*** hosted by IIT Gandhinagar on 27 July 2023.The title of his poster was ***"Understanding the Dust Properties and Clustering Structure of the Giant Molecular Cloud G148.24+00.41"*** authored by Vineet Rawat and M.R.Samal.

5. Book ***"Aeronomy of Mars"*** authored by ***Prof. S. A. Haider***, Honorary Professor, Planetary Sciences Division of PRL has been published by the ***Springer***. More details can be accessed from the following link.
https://www.amazon.in/Aeronomy-Mars-Astrophysics-Science-Library/dp/9819931371/ref=sr_1_34?qid=1689918457&refinements=p_27%3AS.+A.+Haider&s=books&sr=1-34

6. ***Prof. Duggirala Pallam Raju***, Senior Professor, and Dean, PRL, has been ***elected as a Corresponding Member for Section 1 Basic Sciences of the International Academy of Astronautics (IAA)***.

HEARTY WELCOME TO NEW MEMBERS

NAME: DR. SUBHADYOUTI BOSE

DESIGNATION: POST DOCTORAL FELLOW

DATE OF JOINING: 10.07.2023

DIVISION/AREA: PLANETARY SCIENCE DIVISION

NAME: MR. VAIBHAV KATYAL

DESIGNATION: JUNIOR RESEARCH FELLOW-I (HUB)

DATE OF JOINING: 13.07.2023

DIVISION/AREA: ATOMIC, MOLECULAR AND OPTICAL PHYSICS DIVISION

NAME: MR. AMIT CHATURVEDI

DESIGNATION: JUNIOR RESEARCH FELLOW

DATE OF JOINING: 14.07.2023

DIVISION/AREA: UDAIPUR SOLAR OBSERVATORY

NAME: MS. ANKITA CHAURASIA

DESIGNATION: JUNIOR RESEARCH FELLOW

DATE OF JOINING: 14.07.2023

DIVISION/AREA: SPACE AND ATMOSPHERIC SCIENCES DIVISION

NAME: MR. HASIL DIXIT

DESIGNATION: JUNIOR RESEARCH FELLOW

DATE OF JOINING: 14.07.2023

DIVISION/AREA: UDAIPUR SOLAR OBSERVATORY

NAME: MR. RISHAV SAHOO

DESIGNATION: JUNIOR RESEARCH FELLOW

DATE OF JOINING: 14.07.2023

DIVISION/AREA: PLANETARY SCIENCE DIVISION

NAME: MR. RITIK DALAKOTI

DESIGNATION: JUNIOR RESEARCH FELLOW

DATE OF JOINING: 14.07.2023

DIVISION/AREA: ASTRONOMY AND ASTRPHYSICS DIVISION

NAME: MS. AISHWARYA SINGH

DESIGNATION: JUNIOR RESEARCH FELLOW

DATE OF JOINING: 17.07.2023

DIVISION/AREA: GEOSCIENCES DIVISION

NAME: MR. ANTARIKSHA MITRA

DESIGNATION: JUNIOR RESEARCH FELLOW

DATE OF JOINING: 17.07.2023

DIVISION/AREA: PLANETARY SCIENCE DIVISION

NAME: MR. HIMANSHU SEKHAR BAL

DESIGNATION: JUNIOR RESEARCH FELLOW

DATE OF JOINING: 17.07.2023

DIVISION/AREA: GEOSCIENCES DIVISION

NAME: MR. PRIYADARSHEE P. DASH

DESIGNATION: JUNIOR RESEARCH FELLOW

DATE OF JOINING: 17.07.2023

DIVISION/AREA: ASTRONOMY AND ASTROPHYSICS DIVISION

NAME: MR. RISHI CHAURASIA

DESIGNATION: JUNIOR RESEARCH FELLOW

DATE OF JOINING: 17.07.2023

DIVISION/AREA: ATOMIC, MOLECULAR AND OPTICAL PHYSICS DIVISION

NAME: MS. SIMRAT KAUR

DESIGNATION: JUNIOR RESEARCH FELLOW

DATE OF JOINING: 17.07.2023

DIVISION/AREA: UDAIPUR SOLAR OBSERVATORY

NAME: MS. SONALI PANDA

DESIGNATION: JUNIOR RESEARCH FELLOW

DATE OF JOINING: 17.07.2023

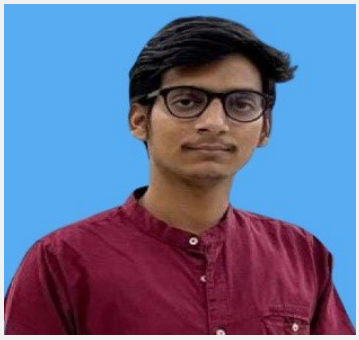
DIVISION/AREA: ATOMIC, MOLECULAR AND OPTICAL PHYSICS DIVISION

NAME: MR. VISHWA VIJAY SINGH

DESIGNATION: JUNIOR RESEARCH FELLOW

DATE OF JOINING: 17.07.2023

DIVISION/AREA: UDAIPUR SOLAR OBSERVATORY



NAME: MR. DINESH MISHRA

DESIGNATION: JUNIOR RESEARCH FELLOW

DATE OF JOINING: 24.07.2023

DIVISION/AREA: UDAIPUR SOLAR OBSERVATORY

NAME: MS. VRUTI GOHEL

DESIGNATION: LABORATORY ASSISTANT DOAM

DATE OF JOINING: 24.07.2023

DIVISION/AREA: GEOSCIENCES DIVISION

NAME: MS. SHIPRA

DESIGNATION: JUNIOR RESEARCH FELLOW

DATE OF JOINING: 26.07.2023

DIVISION/AREA: PLANETARY SCIENCE DIVISION

NAME: MR. SHIVAM PARASHAR

DESIGNATION: JUNIOR RESEARCH FELLOW

DATE OF JOINING: 27.07.2023

DIVISION/AREA: SPACE ATMOSPHERIC AND SCIENCES DIVISION

NAME: MR. KUSHAGRA SRIVASTAV

DESIGNATION: JUNIOR RESEARCH FELLOW

DATE OF JOINING: 28.07.2023

DIVISION/AREA: ASTRONOMY AND ASTROPHYSICS DIVISION

VISITORS

1. **Shri Utsav Parmar**, Deputy Director of Doordarshan, Ahmedabad visited PRL on 07.07.2023.

Cyber Security Awareness – Mobile Security & Safety

Jigar Raval, Computer Networking & Information Technology Division

Always Use Genuine Official Store to Download and Install Apps.

Always verify app before downloading and accordingly grant required permission to the App.

Always use license Antivirus. Keep Operating System, Antivirus and other Apps Updated with latest version.

Review Apps Permission periodically. Uninstall the Apps, which are not in use.

Disable features like auto login, auto password saving, auto form fill, credit card auto saving etc.

Regularly Take Backup of Important Files.

Keep emergency contact number on your lock screen.

Hide Notification Content Display on Lock Screen.

Never Leaves Your Mobile Unattended. Lock Your SIM with PIN.

Always Lock Mobile Phone Screen using PIN/Pattern.

Turn ON Wifi or Bluetooth only when required. Avoid Use of Public Wifi.

Ensure mobile repairing under your supervision. Otherwise, factory reset it before giving it for repairing.

Refrain from Clicking on Malicious Links. Do not install any apps received through SMS/Email or any other means.

Never share personal details to unknown caller or email/SMS sender. Never respond back to unknown video caller.

Keep Your Mobile's unique IMEI and other important numbers handy.

Always Spare Some Time With Family and Aware them about Cyber Security & Safety

https://www.freepik.com/free-photo/caucasian-mom-dad-hugging-children-using-tablets-phone- smiling_9988331.htm

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