



Newsletter of the Physical Research Laboratory

THE SPECTRUM

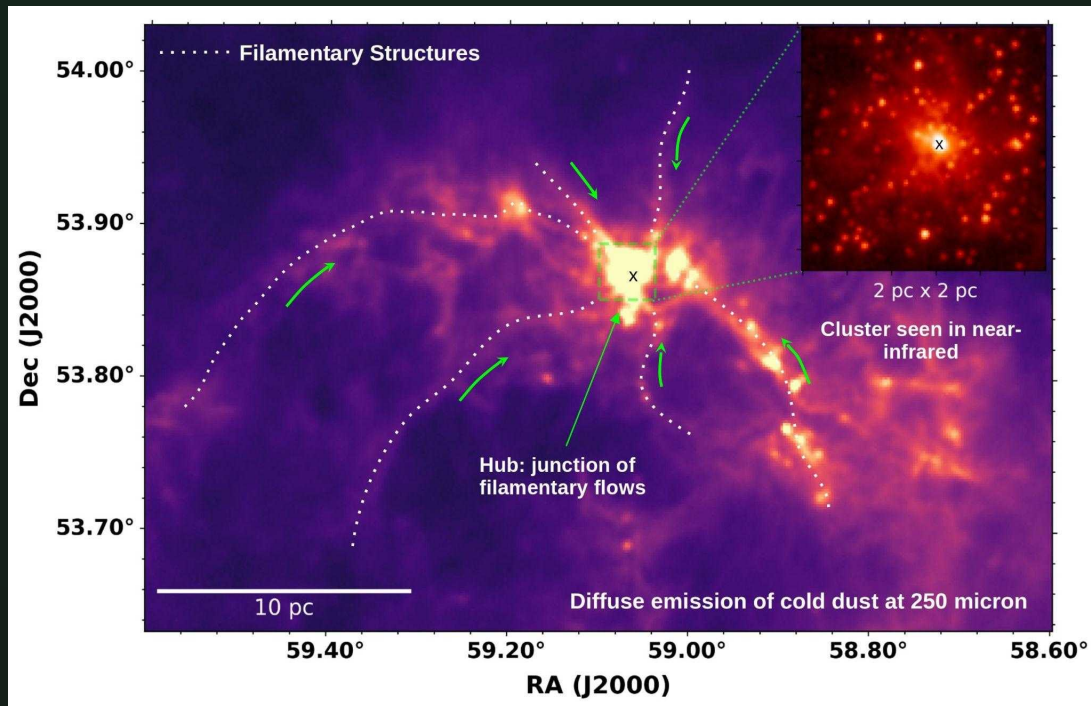


Image of the Month

Herschel 250 μm image of G148.24+00.41, revealing the filamentary structures in its central area. The inset image shows the zoomed-in view of the central region in Spitzer 3.6 μm , which shows the presence of an embedded star cluster in the hub. The cross sign shows the position of the massive young stellar object.



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Compositional diversity in the Mare Marginis and Mare Smythii on the Moon

(Neha Panwar, Neeraj Srivastava, Megha Bhatt, Anil Bhardwaj)

The Author



Neha Panwar

The Marginis-Smythii region of the eastern limb of the Moon is a unique geological setting with the presence of equally widespread volcanism both inside and outside of an impact basin. Mare Marginis (13.3°N, 86.1°E) is a large mare deposit lying north of the pre-Nectarian Smythii Basin (13.3°N, 86.1°E). The basalts from Mare Marginis are deposited in a topographically low area outside an impact basin, i.e. the Smythii Basin. A detailed investigation of the Mare Marginis and Mare Smythii basalts using the Moon Mineralogy Mapper (M3) data presented in the study reveals the compositional diversity of the basalt deposits. The study reveals that the basalts in the Mare Marginis can be divided into two distinct units: i) the central and eastern Marginis basalts that are spectrally similar to the Mare Smythii basalts, and ii) the western lacus, described as Margins west which is a small basalt deposit in the western fringes of Mare Marginis having a spectral composition different from the rest of Mare Marginis and Mare Smythii. It is also observed that the volcanism in this compositionally distinct unit of Margins west occurred up to ~3.1 Ga when volcanism was still active in the Smythii Basin. It has been inferred that the volcanism in Mare Marginis was influenced by both; Crisium and Smythii Basins implying that the pre-existing structures in the lunar crust generated by large-scale impacts play an important role in the volcanism on the Moon.

Source/Reference of the Work: <https://doi.org/10.1016/j.icarus.2023.115496>

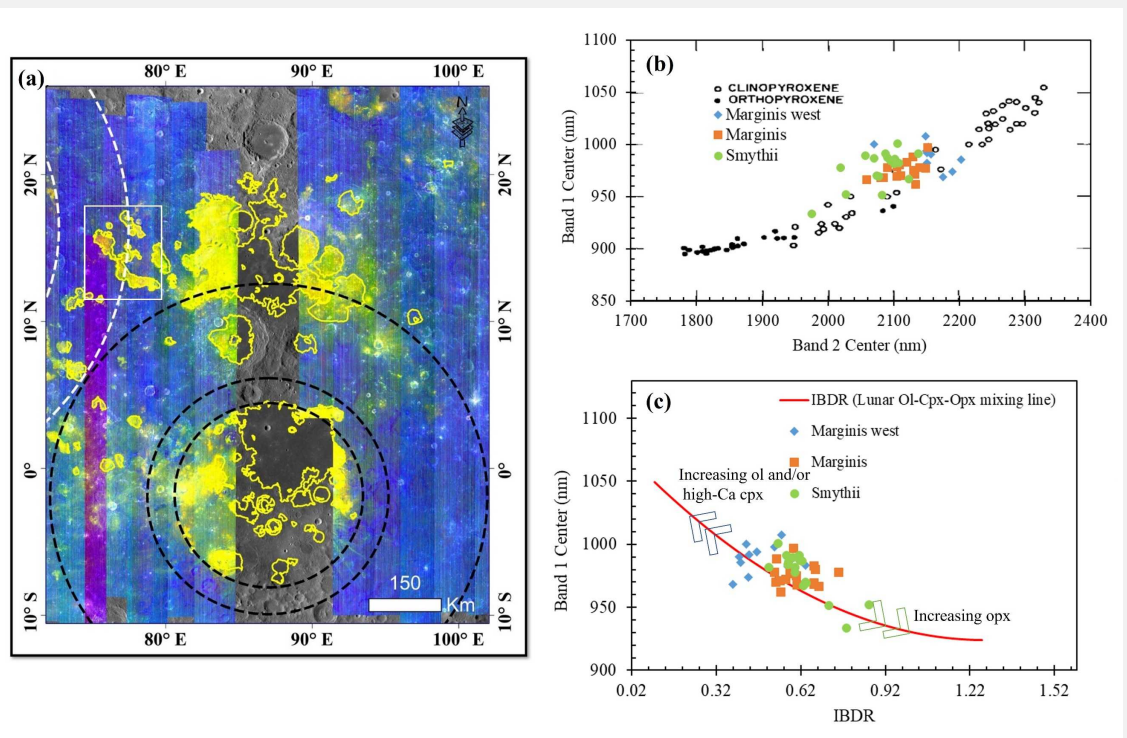


Figure Caption: (a) M3 IBD-based FCC (R = 1000 nm IBD, G = 2000 nm IBD and B = Reflectance at 1489 nm) of the study area with LROC WAC as the base map. (b) BC1-BC2 plot and (c) BC1-IBDR plot showing the classification of the pyroxenes.

IC 5146 Dark Streamer: The First Reliable Candidate of Edge Collapse, Hub-filament Systems, and Intertwined Sub-filaments

(**Lokesh Kumar Dewangan**, Naval Kishor Bhadari, A Men'shchikov., E. J. Chung, R. Devaraj, C. W. Lee, Arup Kumar Maity, T. Baug)

Massive stars ($M > 8 M_{\text{sun}}$) are known to play a significant role in the energy budget of galaxies via their UV radiation, wind, and supernova events. However, the physical processes governing the birth of massive stars are still not well understood. Dust and molecular filaments are actively involved in star formation processes (including massive stars). There are two popular scenarios when it comes to the role of filaments in star formation. One is called the “End-Dominated Collapse (EDC)” scenario, where isolated filaments collapse faster at their ends due to high gas acceleration. However, the observational signatures of this case are very limited in the literature. In another scenario concerning “Hub Filament System (HFS)”, multiple filaments converge at a common place (i.e., filament-hub), that gain sufficient mass and density to form massive stars. The simultaneous existence of these processes is not well observed and understood. In this relation, we observationally studied a nearby (distance ~ 600 pc) potential massive star-forming site, IC 5146 dark Streamer. High-resolution column density and temperature maps of the IC 5146 region revealed the presence of at least two intertwined sub-filaments, displaying a nearly double helix-like structure (Figure 1a). High-column density regions are traced at the edges of the main filament, where HFSs were found in previous studies. Using the $^{13}\text{CO}(1-0)$ and $\text{C}^{18}\text{O}(1-0)$ line data cubes, the existence of two cloud components around ~ 2 km/s and ~ 5 km/s towards the main filament is investigated (Figure 1b). Overall, the interaction between these cloud components might have formed the observed HFSs at the filament edges. Our results favor a scenario, which first predicts the formation of the main filament by a collision of two supersonic turbulent gas flows, and then the scenario favors the origin of the intertwined system of velocity-coherent substructures in the main filament due to residual turbulent motions and self-gravity. Overall, the IC 5146 Streamer can be recognized as the first reliable candidate of multiple processes of edge collapse, HFSs, and intertwined

The Author



Lokesh Kumar Dewangan

sub-filaments together.

Source/Reference of the Work:

<https://doi.org/10.3847/1538-4357/acbcc>

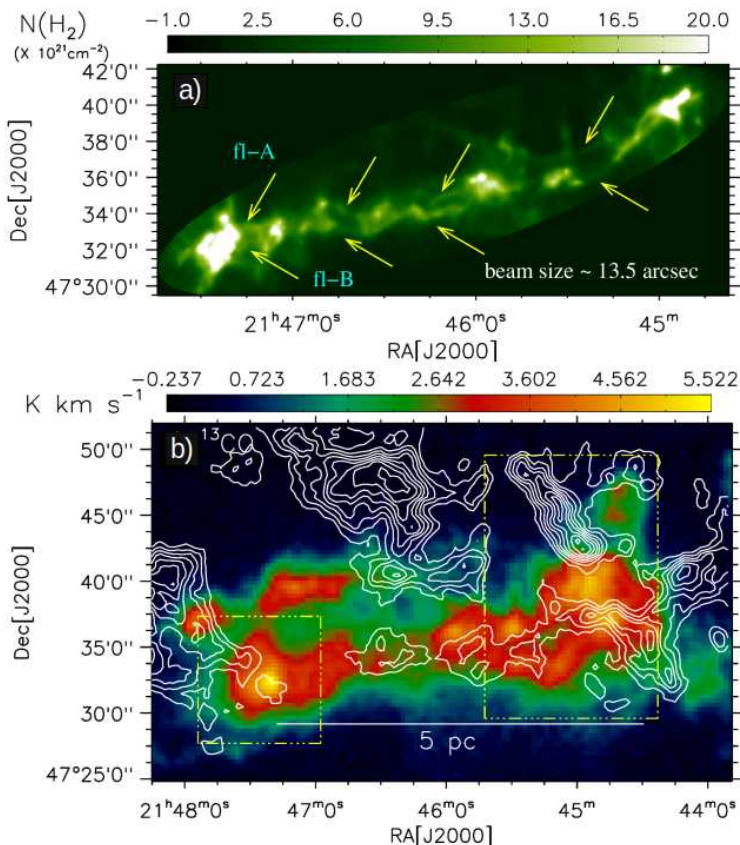


Figure Caption: a) H_2 column density map of IC 5146 Dark Streamer. The possible intertwined filaments (fl-A and fl-B) are marked by arrows. b) TRAO $^{13}\text{CO}(1-0)$ map of integrated intensity observed in velocities [3, 6] km/s (in color-scale) and in [0.8, 2.5] km/s (in contours).

Probing the Global Dust Properties and Cluster Formation Potential of the Giant Molecular Cloud G148.24+00.41

(Vineet Rawat, M. R. Samal, D. L. Walker, A. Zavagno, A. Tej, G. Marton, D. K. Ojha, Davide Elia, W. P., J. Jose, C. Eswaraiah)

The Author



Vineet Rawat

A group of stars that are gravitationally bound to one another is called a star cluster. Massive to intermediate-mass ($> 10^3 M_{\odot}$) star clusters play a dominant role in the evolution and chemical enrichment of the Galaxy via stellar feedback such as photoionization, stellar winds, and supernovae. Clouds more massive than about $10^5 M_{\odot}$ are potential sites of massive cluster formation. Studying the properties of such clouds in the early stages of their evolution offers an opportunity to test various cluster formation processes. In this work, we investigated such a massive gaseous cloud “G148.24+00.41” of our Galaxy using multiwavelength observations covering wavelengths from near-infrared to millimetre. Our results show the cloud to be of high mass ($\sim 1.1 \times 10^5 M_{\odot}$), low dust temperature (~ 14.5 K), nearly circular (projected radius ~ 26 pc), and gravitationally bound with a dense gas fraction of $\sim 18\%$. From our analyses, we find that the central area of the cloud is actively forming protostars and is moderately fractal with a Q-value of ~ 0.66 . We also find evidence of global mass-segregation in the cloud, with a degree of mass-segregation ~ 3.2 , i.e. the massive stars are 3 times more concentrated towards the cloud’s centre in comparison to low-mass stars. We discuss these results along with the structure and compactness of the cloud, the spatial and temporal distribution of embedded stellar population, and their correlation with the cold dust distribution, in the context of high-mass cluster formation. Comparing our results with models of star cluster formation, we conclude that the cloud has the potential to form a cluster in the mass range $\sim 2000\text{--}3000 M_{\odot}$ through dynamical hierarchical collapse and assembly of both gas and stars. This work highlights how star clusters like Orion Nebula Cluster may emerge from giant molecular clouds.

Source/Reference of the Work: <https://doi.org/10.1093/mnras/stad639>

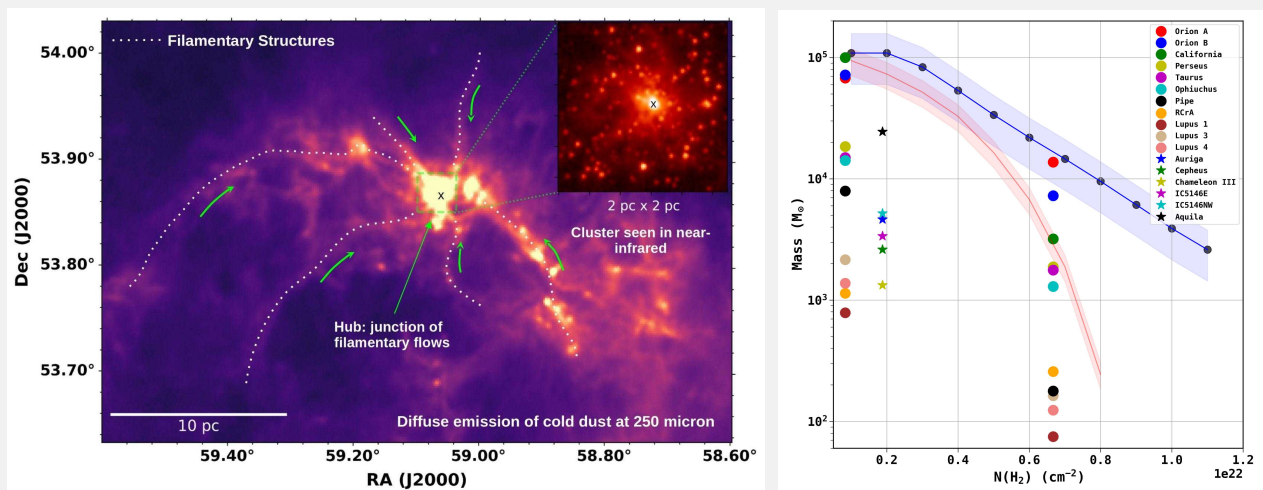


Figure Caption: Herschel 250 μm image of G148.24+00.41 (left panel), revealing the filamentary structures in its central area. The inset image shows the zoomed-in view of the central region in Spitzer 3.6 μm , which shows the presence of an embedded star cluster in the hub. The cross sign shows the position of the massive Young Stellar Object (YSO). The enclosed mass of G148.24+00.41 at various column density thresholds (right panel). The blue and red lines show the cloud mass evaluated from the dust continuum and extinction map, respectively, at different column density thresholds. The coloured dots and stars show the mass of the nearby molecular clouds.

Spectrum of coloured sextet scalars in realistic SO(10) GUT

(Saurabh K. Shukla and Ketan M. Patel)

The Author



Saurabh
K. Shukla

Particles not having any preferential orientation of spin angular momentum in space, i.e., spin-zero, are called scalar particles. These scalar particles are the building blocks of matter and hence are of fundamental importance for our understanding of nature. Higgs boson is the latest and the only entry of scalar particle in the standard model, making the standard model more complete. Although the standard model explains various phenomena with unprecedented accuracy, it is still agnostic about neutrino masses, baryon number violation etc. As the standard model only embeds a single scalar particle, i.e., Higgs, the existence of other scalars would indicate the incompleteness of the standard model. The other scalar particles, including the Higgs boson, can be thought of as a single entity within a larger symmetry structure and hence are naturally embedded in the framework of grand unified theory and predicts some novel processes, yet unobserved, that may point towards a complete theory. In our latest work, "Spectrum of coloured sextet scalars in realistic SO(10) GUT", we have focussed on scalars which couples alike under strong interaction, termed as sextet scalars, which is the same interaction responsible for holding quarks to form protons and neutrons. We performed a comprehensive analysis of the contribution of sextet scalars in neutron-antineutron oscillation, a process in which a neutron converts into an antineutron, thereby violating the baryon number by two units. Moreover, sextet scalars can also contribute to flavour violation, a dormant phenomenon in the standard model, and operationally account for the baryon asymmetry of the universe. We constrain the mass of these sextets in two kinds of realistic SO(10) models having 1) High B-L scale $\sim 10^{15}$ GeV 2) Intermediate B-L scale $\sim 10^{11}$ GeV. Our analysis suggests that sextet scalars heavier than the B-L scale can only and simultaneously satisfy the constraints of neutron-antineutron oscillation, flavour oscillation, Baryogenesis, and perturbativity of effectively generated quartic coupling. In realistic SO(10) models, the B-L scale is dictated by the right-hand neutrino masses. It cannot be made smaller than 10^{11} GeV, implying no observation of neutron-antineutron oscillation in near future experiments. However, if the neutron-antineutron change gets detected, it will constrain many realistic new physics models.

Source/Reference of the Work: <https://doi.org/10.1103/PhysRevD.107.055008>

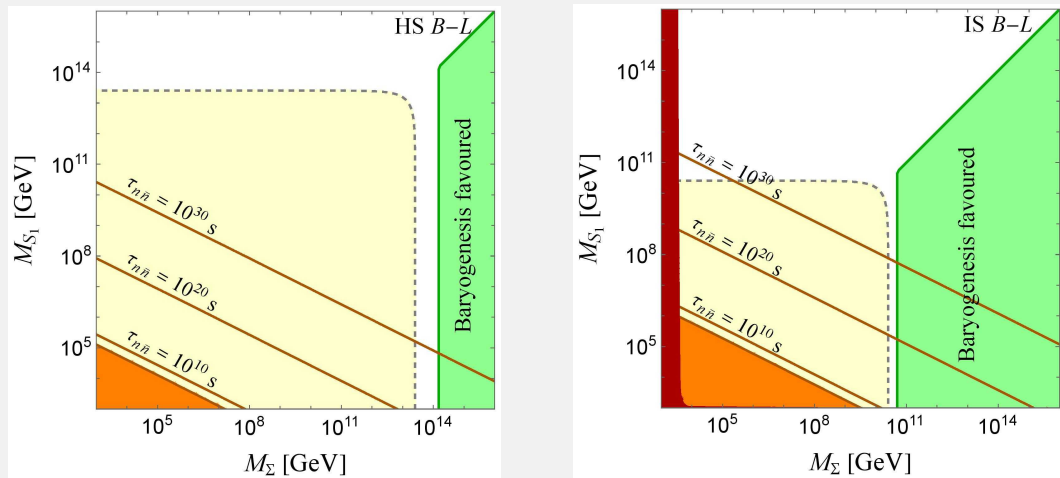


Figure Caption: Constraints on the masses of one sextet (Σ) Vs. another (S_1) for the high (left panel) and intermediate (right panel) B-L breaking scale. The red regions are excluded by the most dominant constraint from the neutral meson-antimeson oscillations. The region shaded in orange is excluded by the current limit on neutron-antineutron oscillation. The yellow region bounded by the dashed contour is disfavoured by the perturbativity of the effective quartic couplings while the region shaded in green is favoured by the baryogenesis constraints.

Enhanced local recycling of moisture via wetlands and forests in North-East Indian subcontinent: a Mini-Amazon

(Akash Ganguly, Harsh Oza, Virendra Padhya, Amit Pandey, Swagatika Chakra, R.D.Deshpande)

The Author



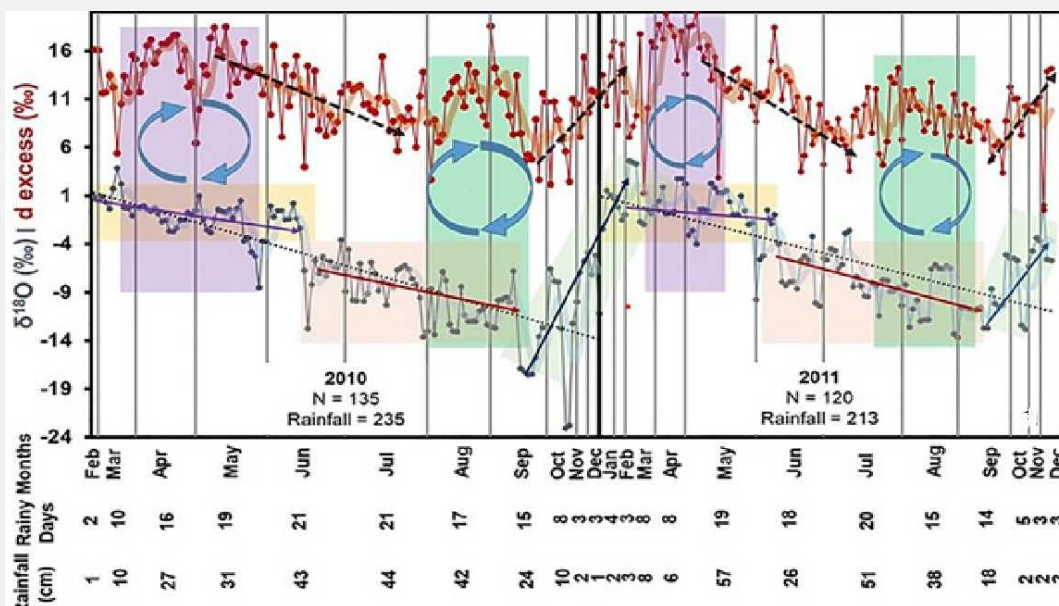
Akash Ganguly

North-East Indian subcontinent, home to the world's wettest place, is a major biodiversity hotspot. The region much like the Amazon rainforest, experiences heavy rainfall and ravaging floods, while boasting vast wetlands and forest cover that are intrinsically linked to rain-formation, but in what way and how much? Answering these fundamental questions is of paramount importance.

Here, we present a study involving continuous records of stable water isotopes in precipitation and surface water, while attempting to elucidate role of wetlands and dense vegetation in recycling continental moisture. The stable isotopes of oxygen (^{18}O) and hydrogen (^2H) in water are efficient tracers of hydrological processes, as their isotopic values vary predictably during physical processes such as evaporation, condensation, transpiration. The peculiar trends in isotopic signature seem to indicate, that contrary to past literature, the wetlands and forests play a significant role in recycling moisture. During March-May, rains from the Nor'westers play a subtle yet vital role by moistening the lower troposphere, rendering it conditionally unstable and suitable for enhanced convection and transpiration. HYSPLIT based estimates attribute ~53% to recycling, far greater than that reported from past studies.

During the onset of Indian Summer Monsoon (ISM), this region is subject to heavy torrential rainfall, accompanied by floods. However, we find the floods to be a necessary evil, intrinsically governing regional hydro-meteorology, and surface dynamics. The floods provide a vast pool of surface water, thus greatly lowering surface viscosity while promoting localised convection. Floods in Brahmaputra bring glacier melt to the valley, isotopically distinct from moisture originating over the Bay of Bengal, highlighting the increased role of continental recycling in precipitation. Furthermore, we find the Shillong Plateau to be a major orographic barrier, obstructing oceanic moisture. Hence, even during ISM, significant contribution from terrestrially recycled sources (~38 %) is estimated.

During Post-Monsoon, with the southward migration of ITCZ, we estimate a greatly increased role of continental recycling (~67 %). Considering the dwindling wetlands and forest-cover, our study highlights their indispensable role in governing regional hydro-meteorology and water availability.



Source/Reference of the Work:

<https://doi.org/10.1038/s41598-023-27577-5>

Figure Caption: Isotopic trends in Precipitation and river water. The daily isotope records of precipitation collected at Jorhat during 2010–2011. The enriched $\delta^{18}\text{O}$ and high d -excess during Pre-monsoon (Mar–May) coupled with conspicuous slightly increasing trend of d -excess during latter half of the ISM (June–Sep) is indicative of hugely important role of locally recycled moisture contributing to precipitation.

N-graphene synthesized in astrochemical ices

The Author

(**B Sivaraman**, K K Rahul, M Ambresh, D Sahu, J K Meka, S -L Chou, Y -J Wu, D Gupta, A Das, J -I Lo, B -M Cheng, B N Rajasekhar, Anil Bhardwaj, H Hill, P Janardhan, N J Mason)



Bhalamurugan Sivaraman

This is the first experimental proof for the synthesis of graphene and graphene quantum dots at very low temperatures, < 10 K, in analogues experiments simulating ism cold dust. Icy mantles of benzonitrile, recently identified molecule in the ISM, was irradiated by vacuum ultraviolet photons and then gradually warmed to room temperature. The left over residue from the chemical changes brought by irradiation was then analysed using high resolution transmission electron microscope which led to the find of graphene and graphene quantum dots. Our experimental result has three implications [1] graphene can be present on the cold ISM dust containing aromatic molecules [2] graphene quantum dots contribute to the ISM emission and [3] graphene and graphene quantum dots contribute to Titan's haze.

Source/Reference of the Work: <https://doi.org/10.1140/epjd/s10053-023-00590-z>

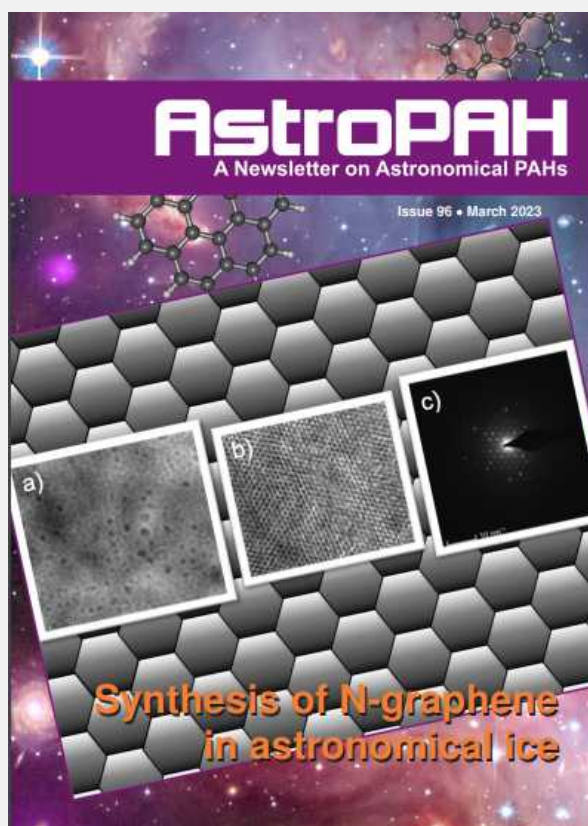


Figure Caption: The cover page of the work that appeared in AstroPAH (Volume – 96; 27 March 2023). The HR-TEM images of graphene and the diffraction pattern are shown.

Likelihood of Martian Moons as Dust Sources in light with Juno Observations

(J. P. Pabari)



Jayesh P. Pabari

Juno observations show dust halo near Mars, contributing to Zodiacal light, the source of which is yet to be known. It is interesting for scientists to understand whether dust primarily comes from the Martian moons. Here we investigate Phobos/Deimos as likely sources of interplanetary dust near Mars. Incoming dust at the Martian moons impact their surface and produce ejecta, a part of which can escape easily to space. Results of escaping mass rates are presented and compared with incoming mass rates through a parameter called Mass Escape Ratio. The results show higher ratio for a wide range of particles, inferring a large amount of effective mass loss from the moons. From whatever is lost, smaller particles ($< 0.1 \mu\text{m}$) can escape, while larger particles are influenced by gravitational pull of Mars. Further, from the larger particles, those with sizes greater than critical size (i.e., $\sim 10 \mu\text{m}$) remain in a ring/torus for a specific lifetime and afterwards, they get released from the gravitational effect of Mars. Since, incoming dust creates the ejecta continuously from Phobos/Deimos, the process of the release of particles after the lifetime is also continuous. On the other side, flux of interplanetary dust is derived from Juno observations of dust impact rates between 1 to 5 AU heliocentric distance. An increase in the flux observed by Juno around 1.5 AU and the results of larger, continuous escaping mass from the moons indicate Phobos and Deimos to be the local

sources of dust bands observed by Juno spacecraft.

Source/Reference of the Work:

<https://doi.org/10.1093/mnras/stad1045>

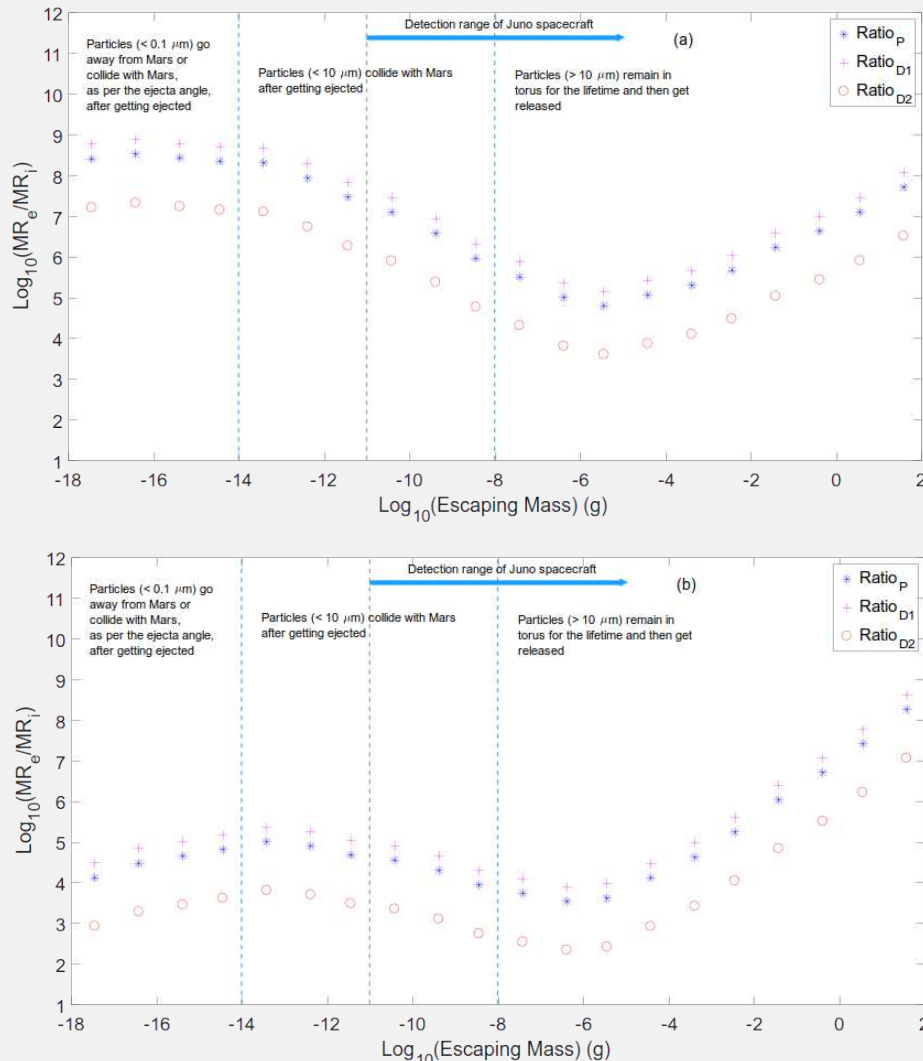


Figure Caption: Results of MER for Phobos, Deimos in Case 1 and Deimos in Case 2 in (blue) asterisk mark, in (magenta) plus sign and (red) circle, respectively, as a function of escaping particle mass, with (a) MER results corresponding to the lower bound of mass loss from the moons and (b) MER results corresponding to the upper bound of mass loss from the moons. Though the escaping mass rate from Phobos is dominating, the effective mass escape from Deimos could be higher. The variation in MER is little more than 2 orders of magnitude.

Transverse momentum resummation at $N^3LL+NNLO$ for diboson processes

The Author



Satyajit Seth

(John M. Campbell, R. Keith Ellis, Tobias Neumann, **Satyajit Seth**)

The Standard Model of particle physics remains to be the most successful theory to date in explaining three of the four fundamental forces in Nature. In this model, spin-1 gauge bosons act as force carriers and the spin-0 Higgs boson provides mass to its massive elementary constituents. Large experimental efforts are dedicated at the Large Hadron Collider (LHC) to test the phenomena predicted by this theoretical model and remarkable agreements are seen on several occasions. The quest to do such measurements at unprecedented accuracy is on and therefore, theoretical predictions need to be very very precise. We present theoretical estimations of a few diboson production processes at the LHC at a very high accuracy, as diboson processes are one of the most accessible and stringent probes of the electroweak gauge structure of the Standard Model. They will be probed at the percent level at the high-luminosity LHC, challenging current theory predictions. We present transverse momentum resummed calculations at $N^3LL+NNLO$ accuracy for the processes ZZ , WW , WZ , WH and ZH , compare our predictions with most recent LHC data and present predictions at 13.6 TeV LHC including theory uncertainty estimates. Our calculations are made publicly available so as to allow future analyses to take advantage of improved predictions.

Source/Reference of the Work: [https://doi.org/10.1007/JHEP03\(2023\)080](https://doi.org/10.1007/JHEP03(2023)080)

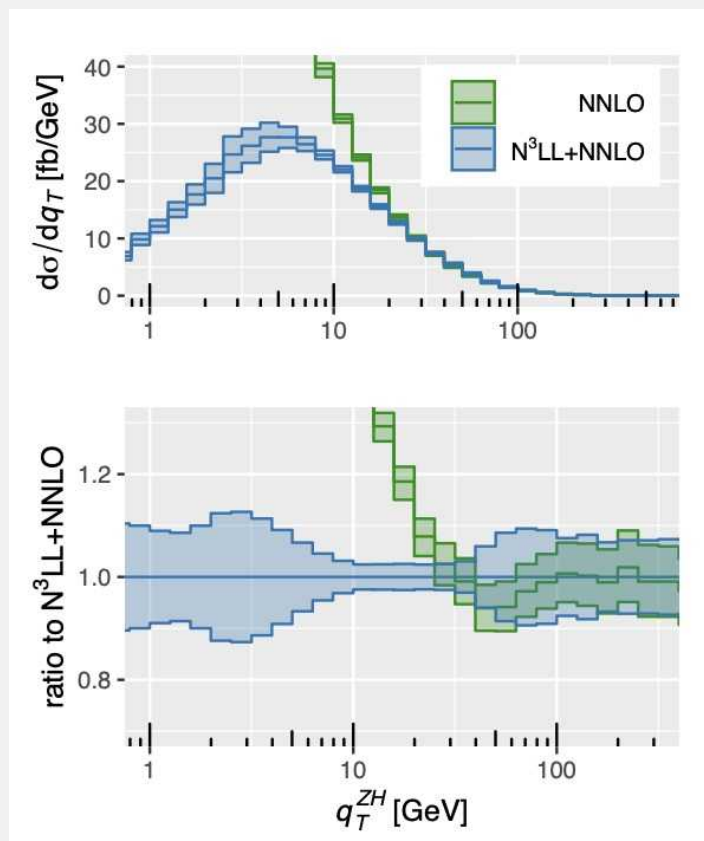


Figure Caption: ZH transverse momentum distribution at $N^3LL+NNLO$ compared to fixed order NNLO

3rd Dr. Bibha Chowdhuri Memorial Lecture



Dr. Bibha Chowdhuri



Prof. Rama Govindarajan

Professor and Dean Academic, International Centre for Theoretical Sciences, Tata Institute of Fundamental Research (ICTS-TIFR), Bengaluru

Title: Dynamics of small particles in flow

Date: 7th March 2023.

Scientists have studied the interesting behavior of small particles in flow and their propensity to clumping. These particles can be found in a range of environments, from plankton in the ocean to water droplets in clouds. The lecture highlighted the approach taken by researchers to understand this phenomenon and the multiple approximations involved in the process. The speaker also discussed the impact of a departure from sphericity on particle interactions and how it modifies clumping by suppressing an instability. Understanding the behavior of small particles in flow and their propensity to clump has important implications for various fields of study, such as the dynamics of oceanic and atmospheric ecosystems. The recent developments in this area of research have shed light on the complex behavior of these particles that opened up new avenues for further study. The lecture emphasized the importance of studying the behavior of small particles in flow and their clumping behavior in order to better understand various natural phenomena and thus provided valuable insights in this direction.

Available at PRL Youtube channel - <https://www.youtube.com/watch?v=KsSbv8vo128>

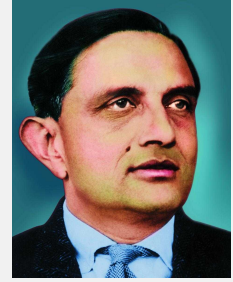


Prof. Govindarajan felicitated by Prof. Anil Bharadwaj (Director, PRL)



Prof. Govindarajan during the interaction with PRL's women

5th PRL-IAPT Dr. Vikram Sarabhai Lecture



Dr. Vikram Sarabhai



Prof. D. Pallamraju

Senior Professor, Space and Atmospheric Sciences Division and, Dean, Physical Research Laboratory, Ahmedabad.

Title: Space Research Through Optical Window

Date: 22nd March 2023.

Space has always fascinated humans. Especially, the sight of the stars, the galaxies, and the planets have kindled curiosity in the minds of many a scholars, thinkers as well as children since these objects can be seen with a naked eye. There is yet another light in the near earth region which an unaided eye cannot “see”, but understanding the variations in its brightness is important for fundamental investigations of the physics of sun-earth interactions as well as for several aspects of applications in our day-to-day life – as we are increasingly dependent on space-based technologies.

Scientists have invented and developed innovative methods to remotely sense the behavior of the atmospheric regions ‘up above the sky’ using this light called the “airglow” or the “aurora” as the tracer of the medium. The behavior of these airglow or auroral emissions tell us about the weather at that altitudes in terms of the wave propagations, temperatures, winds, etc. These optical airglow emissions are present not only in the night but also in the daytime, just as do the stars, galaxies, and planets. PRL has pioneered the development of innovative techniques for the measurement of airglow in the daytime, akin to seeing the stars in the broad daylight, which have resulted in several new insights on the behavior of the near-earth space. This talk attempted to give a flavor of the recent developments made in the measurement techniques and the discoveries made in the understanding of solar-terrestrial interactions. The speaker added that some such optical techniques are being developed for space-based research of not only the Earth’s upper atmosphere but also of the atmospheres of several other planets in forthcoming ISRO’s space missions. It was emphasized that this is one of the frontier areas of research for the young physicists who are planning on taking up research as their career.

Available at PRL Youtube channel - <https://www.youtube.com/watch?v=Jss0YS6u8tA>



Prof. D. Pallamraju delivering 5th IAPT Lecture

4th Indian Planetary Science Conference (IPSC) - 2023



Chairman addressing the IPSC attendees

The Indian Planetary Science Association (IPSA) organised the 4th Indian Planetary Science Conference 2023 during 22-24th March, 2023 at Physical Research Laboratory (PRL), Ahmedabad. The conference aimed at highlighting the recent advances, results and studies related to the atmosphere, surface and interior of planetary bodies in the solar system, including planetary processes and early solar system evolution. IPSA was also formally inaugurated during the event.

The event began with an inaugural session on 22nd March at K. R. Ramanathan Auditorium of Physical Research Laboratory, Ahmedabad. Prof. Anil Bhardwaj, Director PRL welcomed the dignitaries and the participants of IPSC-2023. The conference was inaugurated by the chief guest Shri S. Somanath, Secretary DOS & Chairman ISRO and Shri A.S. Kiran Kumar, Chairman PRL, Council of Management. Dignitaries Shri Kartikeya V. Sarabhai, Shri M. Maheshwar Rao (Additional Secretary, DOS), and Shri Rajesh Khandelwal, Director DECU graced the occasion. The keynote address was delivered by Shri A.S. Kiran Kumar where he emphasized upon generating human resource for efficient utilization of the space science and planetary data. IPSA was then formally inaugurated and its logo and website were unveiled by the dignitaries. Prof. Varun Sheel (Convener IPSC 2023) gave an overview of the conference and IPSA. Later, Shri S. Somanath addressed the gathering and delivered the inaugural talk on “Indian Accomplishments in Space Science and Planetary Exploration”. Key results from Chandrayaan-1, Chandrayaan - 2, Mars Orbiter Mission (MOM), and AstroSat were presented.



IPSC Inauguration, Lighting of lamp



IPSA Inauguration



Early Career Award Group Photo

Available at PRL Youtube channel - <https://www.youtube.com/watch?v=vf-tBT7UTx4>

Shri Somanath also mentioned about the upcoming missions such as Chandrayaan-3, Aditya L1, and Gaganyaan. He also briefed upon missions in discussion and conceptualization phase such as, Venus Mission, Mars Landing Mission, LuPEX, DISHA, and XPOSAT. As a prelude to the IPSC 2023, a two days workshop was organized by PRL, where 50 students of M.Sc., M.Tech., and B.Tech. from 50 different institutions were selected and imparted training on different aspects of planetary science and exploration, along with hands-on experience.

The IPSC-2023 was attended by about 225 delegates from different parts of the country representing various institutions both academic and research, as well as universities and colleges. Few participants from the industry as well as outreach were also present during the event. Around 130 research papers covering various domains of planetary science were presented in nine different sessions during the three-day conference. The topics include the Lunar science and exploration results from missions, Surface and atmospheric process on Mars and Venus, Payload development and instrumentation, studies on solar system processes, meteorites & small bodies, Astrobiology, Astrochemistry and Exoplanets. The presentations included around 60 oral/invited and 70 poster presentations.

The first general body meeting (GBM) of the Indian Planetary Science Association (IPSA) was held on the second day of the event. Along with the newly joined members, several participants of IPSC-2023 also participated in the GBM. The GBM included a brief description of the objectives of IPSA, its current and planned activities, introduction of the executive council and new members. Four different committees were formed during the GBM to enhance the visibility of IPSA, to induct new members PAN India, and to plan and execute future meetings of IPSA.

IPSC-2023 was concluded with a discussion and feedback session from the participants. Early Career Researcher Awards were presented to seven young researchers during the concluding session.

Convener: Prof. Varun Sheel

Co-convener's: Dr. Neeraj Srivastava and Dr. K. Durga Prasad

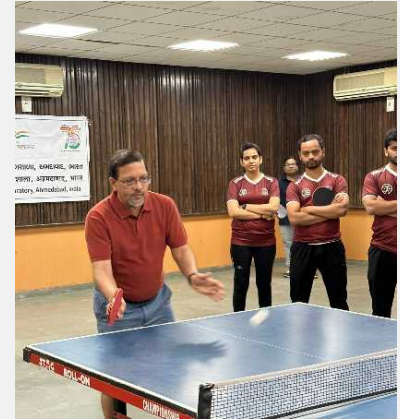


Poster Presentation



Group Photo

Annual Table Tennis Tournament for the year 2022-23



Physical Research Laboratory is dedicated to fostering talent and providing opportunities for its staff and researchers from diverse backgrounds. As we celebrate Azadi ka Amrit Mahotsav, we are proud to continue this tradition by organizing our annual Table Tennis tournament during 11th and 12th March 2023.

The tournament was inaugurated by Dr. Anil Bhardwaj, the Director of PRL, who wished all the participants good luck and encouraged them to play with sportsmanship. The tournament witnessed many nail-biting, fun-filled, and highly competitive games spanning various formats like Singles, Veteran Singles, Doubles, Team events, Mix-Doubles, and Lucky Doubles. This year, the overall participation in the tournament was overwhelming. This year, 36 staff and researchers, including 30 men and 6 women, enthusiastically participated in the tournament, showcasing their skills and camaraderie. The cheering and applause from the crowd added to the excitement and created a lively atmosphere throughout the two days event. As the great Arthur Ashe once said, "Success is a journey, not a destination. The doing is often more important than the outcome." We congratulate all the participants and winners, and look forward to continuing to support their journeys towards success.

EVENT CATEGORIES	Results		
	Winner	Runner up	Third Place
Veteran Singles	DR. ANIL BHARDWAJ	DR. J BANERJI	DR. SOM KUMAR SHARMA
Women Singles	MS. MONIKA DEVI	MS. MEGHNA SONI	DR. SADHANA SINGH
MIX Doubles	MS. MEGHNA SONI MR. ATUL ASHOK MANKE	MS. MONIKA DEVI MR. ANIRBAN GHOSH	DR. SADHANA SINGH MR. RAM LAKHAN AGRAWAL
Open Singles	MR. ANIRBAN GHOSH	DR. GOUTAM K SAMANTA	DR. RAVINDRA PRATAP SINGH
Open Doubles	MR. RAM LAKHAN AGRAWAL MR. ANIRBAN GHOSH	MR. SENTHIL BABU T J MR. B G THAKOR	MR. SHASHANK URMALIA DR. SOVAN SAHA
Lucky Doubles	MR. ATUL ASHOK MANKE MR. RAM LAKHAN AGRAWAL	MR. PRADEEP K SHARMA MR. ANIRBAN GHOSH	MS. MONIKA DEVI MR. B G THAKOR
Team Event	AMOPH DR. GOUTAM K SAMANTA MR. ANIRBAN GHOSH MS. MONIKA DEVI	SPASC DR. RAVINDRA PRATAP SINGH MR. ATUL ASHOK MANKE MR. SHASHANK URMALIA DR. SOVAN SAHA	Administration & Services MR. PRADEEP K SHARMA MR. RAM LAKHAN AGRAWAL MR. B G THAKOR MR. SENTHIL BABU T J

We congratulate all the participants and winners, and look forward to continuing to support their journeys towards success.

Result of Annual Table Tennis Tournament for the year 2022-2023 which was conducted on 11th & 12th March 2023

Holi Milan & Holika Dahan

This year, Staff Welfare Committee of PRL organized “Holi Milan and Holika Dahan” program on 7th March 2023 at Thaltej Campus, for the staff and their family members. The program started at around 08:00 pm with formal worship followed by “Holika Dahan” by Dr. Anil Bhardwaj, the Director of PRL and greeted everyone by smearing Gulal. All the participants also sprayed Gulal and hailed each other. Around 160 members took part in this event. Apart from this, there was a program of songs and music, and everyone danced to various themes on this gathering of “Holi Milan”.



Holi Celebration at PRL

Women's Day Celebration



In concurrence with the directives received from the DOS, International Women's Week was celebrated from 1st to 8th March 2023 and International Women's Day on 15th March 2023. A day wise description is as follows:



Prof. Anjana Vyas delivering talk at PRL

- From 1st to 8th March 2023, a poster competition on the theme "Stop Domestic Violence" was organised by the Women Cell at PRL. The posters were to be prepared in Gujarati, Hindi or English. The received posters were displayed in Lift foyer during 01-08 March 2023. These posters were evaluated by a team of five judges and best three were selected. Additionally, a "give your thoughts" board was set up to portray the thoughts on women's empowerment and feedback from the visitors.
- On 1st - 2nd March Self-Defense sessions by Ms Shreya Mishra for women members at Navrangpura and Thaltej Campus were organised and basics of self defense were taught.
- On 6th March - An awareness programme by Dr Shital Patel on Violence against women for the contract staff at Navrangpura Campus was organised.

- On 7th March - Bibha Chowdhuri Memorial Lecture by Dr. Rama was organised.
- On 15th March - IWD celebration was organised and a short cultural programme followed by a talk by Prof. Anjana Vyas on "DigitALL: Innovation and technology for gender equality".

In addition, a charity distribution was carried out at Ahmedabad and USO Campuses where grocery items and school related items (tiffin boxes and bottles) were distributed to needy girls/women. PRL also gifted a bag as a token of appreciation to all its Women employees.



Charity Distributions as part of IWD



Glimpse of posters for competition



Self-defence session at Thaltej Campus

PRL Ka Amrut Vyakhyaan



PKAV-78

Prof. Asha Kaul

Indian Institute of Management Ahmedabad.

Vyakhyaan Title: Demystifying Leadership

Date: 29th March 2023.

The concept of ‘leader’, ‘leader communication’ and ‘leadership’ has gained momentum over the years. Though there is a plethora of research on the topic of ‘leadership’ there is no one definition to which all practitioners and academics subscribe. There are differing outcome-based perceptions and then there are process focused assessments –the debate is ongoing and inconclusive. The question, - ‘Where then can we draw our leadership lessons from?’, becomes all the more pertinent in this environment of uncertainty.

Prof. Asha Kaul proposed that knowledge on the topic can be derived from one of the oldest and longest epics of India – Mahabharata. Written in the third century BC in the form of Itihaas (history), it presents narratives of leader stratagems and propels the reader to draw lessons for almost all fields of operation. All characters in Mahabharata have a narrative which advocates strategies for people in leadership positions or which may be termed as the Leadership Act on how mindsets are created, plans are communicated and executed, the role of love, passion, hatred and envy and the consequences of the same.

The legitimacy of the leadership act – embedded in the moral as well as pragmatic – leads us to the notion of Principled Pragmatism, that is, ethical principles, character and relationships. And what better text than Mahabharata is there which can teach us through the narratives principles of leadership – what should be followed and what should be avoided.

Available at PRL Youtube channel - <https://www.youtube.com/watch?v=tMbPqJtNXVM>

PRL Monthly Publications Digest (February 2023)**Astronomy & Astrophysics Division [4]**

1. Dewangan, Lokesh Kumar, N. K. Bhadari, A. K. Maity, Rakesh Pandey, Saurabh Sharma, T. Baug, C. Eswaraiah, , 2023, Star-forming site RAFGL 5085: Is a perfect candidate of hub-filament system ?, *Journal of Astrophysics and Astronomy (JApA)*, 44, 23, DOI:10.1007/s12036-022-09907-7, Date of Publication: 28/03/2023
2. Dewangan, Lokesh Kumar, N. K. Bhadari, A. Men'shchikov, E. J. Chung, R. Devaraj, C. W. Lee, A. K. Maity, and T. Baug, 2023, IC 5146 Dark Streamer: The First Reliable Candidate of Edge Collapse, Hub-filament Systems, and Intertwined Sub-filaments, *The Astrophysical Journal*, Volume 946, Issue 1, id.22, 16 pp., Date of Publication: 20/03/2023
3. Biswajit Mondal, James A Klimchuk, Santosh V. Vadawale, Aveek Sarkar, Giulio Del Zanna, P. S. Athiray, N. P. S. Mithun, Helen E. Mason, Anil Bhardwaj, 2023, Role of Small-scale Impulsive Events in Heating the X-Ray Bright Points of the Quiet Sun, *The Astrophysical Journal*, Date of Publication: 06/03/2023
4. Vineet Rawat, Mansh R. Samal, D L Walker, A Zavagno, A Tej, G Marton, D K Ojha, Davide Elia, W P Chen, J Jose, C Eswaraiah, 2023, Probing the global dust properties and cluster formation potential of the giant molecular cloud G148.24+00.41, *Monthly Notices of the Royal Astronomical Society*, 521, 2786–2805, <https://doi.org/10.1093/mnras/stad639>, Date of Publication: 01/03/2023

Atomic Molecular and Optical Physics Division [3]

1. Subith Kumar, Ravi K. Saripalli, Anirban Ghosh, Wagner T. Buono, Andrew Forbes, and G.K. Samanta, 2023, Controlling the coverage of full Poincare beams through second-harmonic generation, *Physical Review Applied* 19, 034082 (2023), Date of Publication: 24/03/2023
2. K. M. Muhammed Shameem, Swetapuspa Soumyashree, P. Madhusudhan, Vinitha Nimma, Rituparna Das, Pranav Bhardwaj, Prashant Kumar, Rajesh K. Kushawaha, 2023, Nanosecond and Femtosecond Laser-Induced Breakdown Spectroscopy: Fundamentals and Applications, John Wiley & Sons, Inc. Book: Laser Induced Breakdown Spectroscopy (LIBS): Concepts, Instrumentation, Data Analysis and Applications, Date of Publication: 17/03/2023
3. K. M. Muhammed Shameem, Swetapuspa Soumyashree, P. Madhusudhan, Vinitha Nimma, Rituparna Das, Pranav Bhardwaj, Rajesh K. Kushawaha, 2023, Molecular Species Formation in Laser-Produced Plasma, John Wiley & Sons, Inc. Book: Laser Induced Breakdown Spectroscopy (LIBS) Concepts, Instrumentation, Data Analysis and Applications, Date of Publication: 17/03/2023

Geosciences Division [3]

1. Mishra, S., Tripathi, S.N., Kanawade, V.P., Haslett, S.L., Dada, L., Ciarelli, G., Kumar, V., Singh, A., Bhattu, D., Rastogi, N., Daellenbach, K.R., Ganguly, D., Gargava, P., Slowik, J.G., Kulmala, M., Mohr, C., El-Haddad, I., Prevot, A.S.H., 2023, Rapid night-time nanoparticle growth in Delhi driven by biomass-burning emissions, *Nature Geoscience*, 16, 224–230., Date of Publication: 10/03/2023
2. Bivin G. George, Jyotiranjana S. Ray, Shilpa Patil Pillai, Milan K. Mahala, Sanjeev Kumar, Vivek S. Kale, 2023, C-Sr-Pb isotope systematics of the carbonate sequences of Kaladgi Supergroup, India: Implications for basin evolution and correlation with Proterozoic global events, *Precambrian Research*, Date of Publication: 01/03/2023
3. R. Mandal, A. Das, G. R. Tripathy, A.K. Sudheer, Sanjeev Kumar, R.D. Deshpande, Virendra Kumar, 2023, Impact of soil salinity on groundwater chemistry in semi-arid regions in Western India: Insights from major ion and stable isotopic d^2H_2O , $d^{18}OH_2O$, $d^{13}CDIC$ characteristics, *Groundwater for Sustainable Development*, Date of Publication: 01/03/2023

Theoretical Physics Division [2]

1. John M. Campbell, R. Keith Ellis, Tobias Neumann, Satyajit Seth, 2023, Transverse momentum resummation at $N^3LL+NNLO$ for diboson processes, *Journal of High Energy Physics*, JHEP 03 (2023) 080, Date of Publication: 13/03/2023
2. Ketan M. Patel, Saurabh K. Shukla, 2023, Spectrum of color sextet scalars in realistic $SO(10)$ GUT, *Phys. Rev. D* 107, 055008, Date of Publication: 09/03/2023

Awards & Honours

1. **Ms. Akanksha Arora**, SRF, Space and Atmospheric Sciences Division of PRL has received the **First prize for her (Oral) presentation in the "National Workshop on Boundary layer Exchange Processes and Climate change (NoBLExClim 2023)"** jointly organized by the Ministry of Earth Sciences, Science and Engineering Research Board, Govt. of India, and SRM Institute of Science and Technology, India during 23–24 March 2023 at SRM Institute of Science and Technology, Chennai.
2. **Mr. Devaprasad M**, SRF, Geosciences Division of PRL has received the **3rd prize for his (poster) presentation at "SecoNdary Aerosol FormatioN and grOwth (NANO-2023)"** jointly organized by Centre for Earth, Ocean and Atmospheric Science, School of Physics, University of Hyderabad and Finnish Meteorological Institute, Finland during March 13–14, 2023 at University of Hyderabad.
3. **Dr. Kavutarapu Venkatesh**, Assistant Professor, Space and Atmospheric Sciences Division of PRL has been selected as one of the **Excellent Reviewers of the journal "Earth, Planets and Space" for the year 2022.**
4. **Prof. Anil Bhardwaj**, Director, PRL has been **nominated as a member of the Governing Council of the Indian Institute of Astrophysics for a 3-year term.** He is the only member who has been repeated for the 2nd term in the Governing Council.

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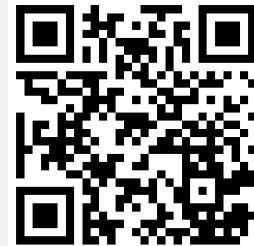
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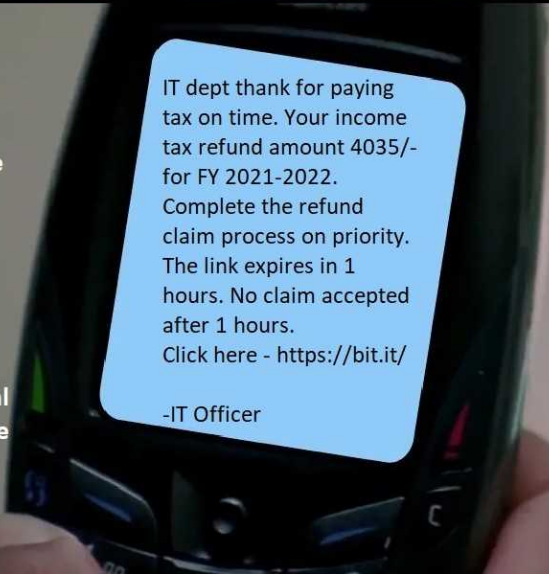
Cyber Security Awareness

 **Cyber Security Awareness – Phishing Message** 
Jigar Raval, Head, CNIT, PRL



*Aware Family Members,
Friends, Colleagues looking
at Phishing Message/Email.*

- Never Click on the Link Received from Unknown Number.
- Always Double Check the Link, especially shorten Link.
- Never Call Back to the Unknown Number.
- Never Share Any Personal Details Over Phone to the Unknown Person or through the Suspicious Link.



Be Vigilant!!!!

Be Cyber Safe!!!!

Report Cyber Crime Incidents on - www.cybercrime.gov.in OR Call on - 1930