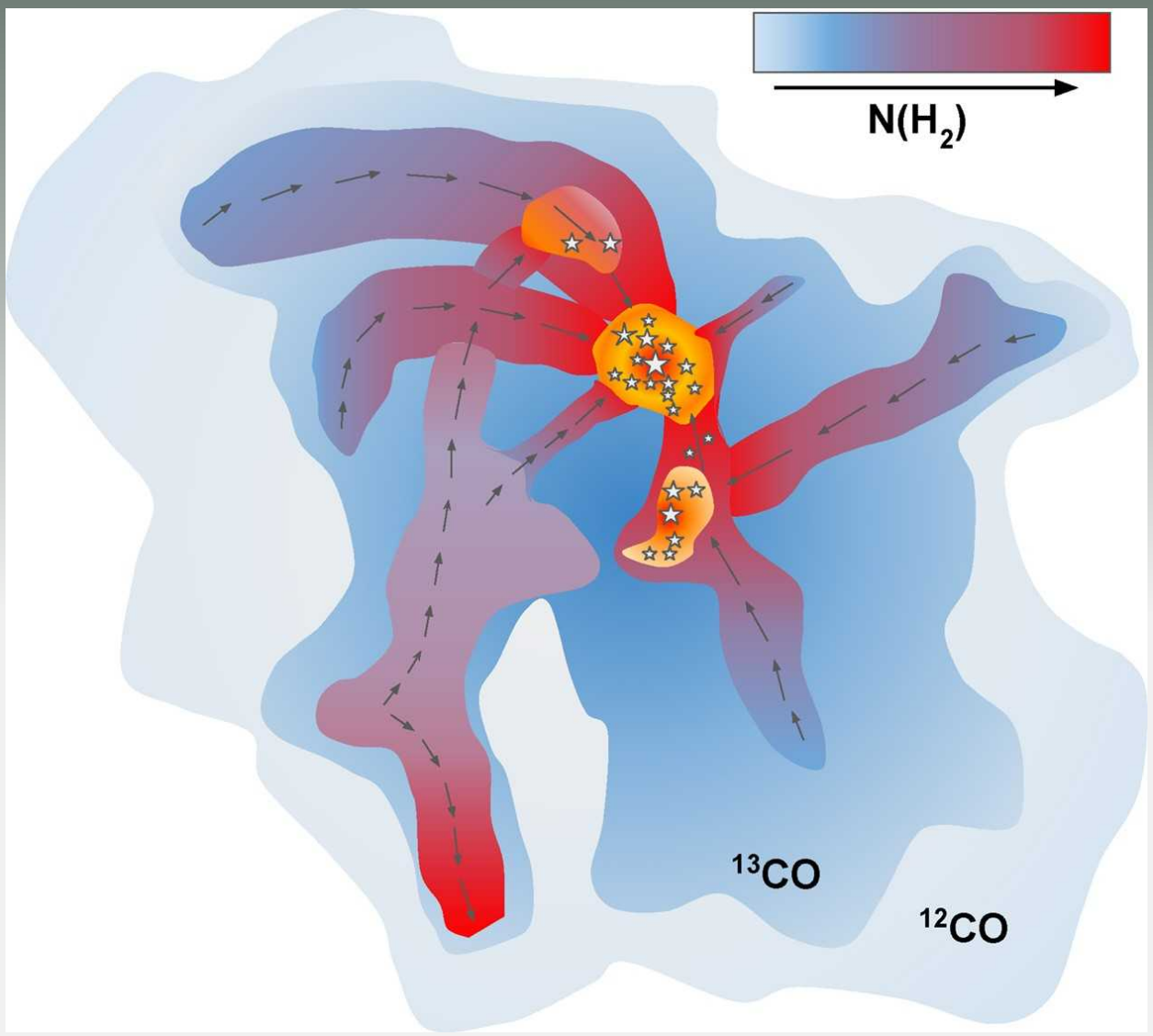
Newsletter of the Physical Research Laboratory

THE SPECTRUM



Cartoon illustrating star cluster formation at the nexus of gaseous river-like filamentary flows, observed in a massive molecular cloud of our own Milky-Way galaxy.

February 2024

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The Author

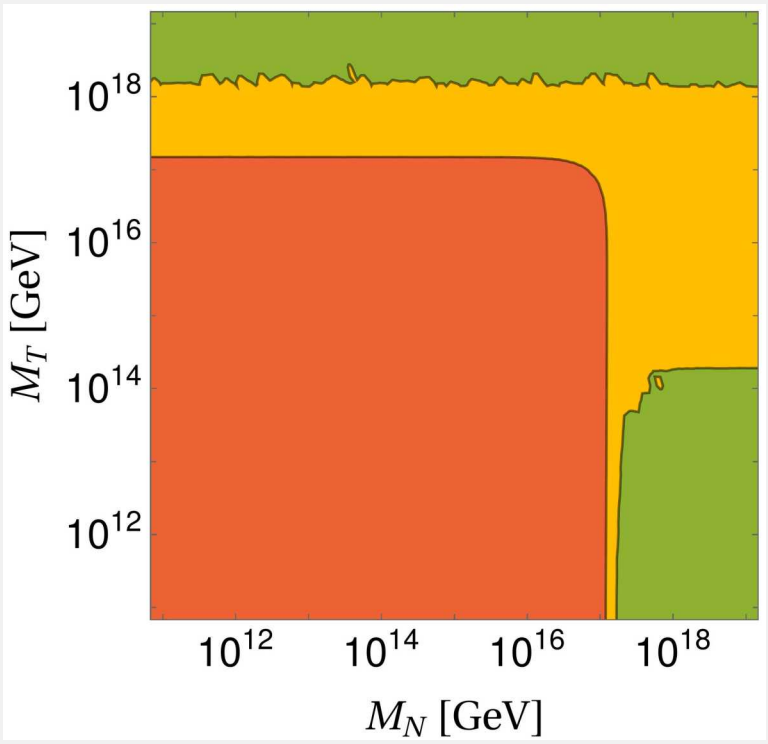
Saurabh Shukla

Quantum Corrections and the Minimal Yukawa Sector of SU(5)

(***Saurabh K. Shukla*** *and Ketan M. Patel)*

The ability of any theory to make precise and testable predictions essentially boils down to the presence of free and tunable parameters in the theory. The standard model (SM) of particle physics, able to explain many observed phenomena, is too plagued with many arbitrary and tunable parameters. Grand unified theory (GUT), of which the standard model could be an effective low energy equivalent, promises to reduce the arbitrary parameters by putting quarks and leptons together, which are otherwise independent in the standard model. However, the minimal GUT models are less efficate as their predictions are inconsistent with the observations. For instance, minimal SU(5) with only five-dimensional Higgs in the Yukawa sector leads to generation-wise mass degeneracy in the down-quark and charged lepton sectors. This inconsistency is usually ameliorated by adding extra degrees of freedom. Dictated by the principle of Occam's razor, lately, we have shown that switching on the quantum corrections in a minimal SU(5) model extended with singlet(s) can viably reproduce the observed fermion mass spectrum, including the leptonic spectrum. The (threshold) corrections induced by the added singlet(s) and the heavier components of five-dimensional Higgs (Triplet scalar) alleviate the aforementioned degeneracy, provided their masses differ by atleast two orders of magnitude. However, a natural way to simultaneously accommodate lighter (the SM Higgs) and heavier (the scalar triplet) components in the five-dimensional Higgs is still the Achilles' Heel of the approach. This method opens up the possibility of its application in other GUT scenarios.

Source/Reference of the Work: *https://doi.org/10.1103/PhysRevD.109.015007*



The variation of chi-squared for different values of Mass of Triplet (M_T) and Mass of Singlet (M_N). The green, yellow, and red areas show where the minimum chi-squared is less than or equal to 3, between 3 and 9, and greater than 9, respectively.

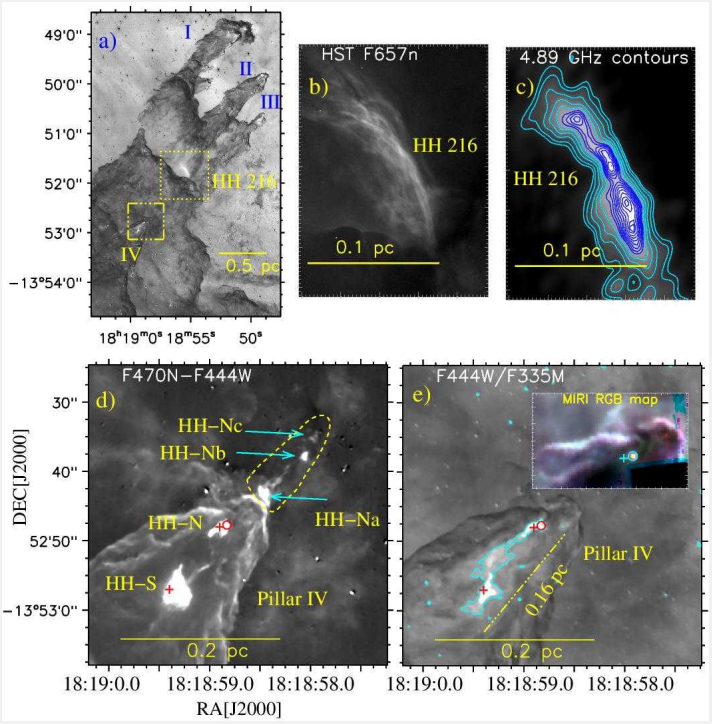
The Author

Lokesh Kumar Dewangan

Deciphering the hidden structures of HH 216 and Pillar IV in M16

(***Dewangan, Lokesh Kumar***; *Jadhav, O. R.; Maity, A. K.; Bhadari, N. K.; Sharma, S.; Padovani, M.; Baug, T.; Mayya, Y. D.; Pandey, R.)*

The 'Pillars of Creation' or 'elephant trunks' in the Eagle Nebula (M16; distance ~1.74 kpc) has been regarded as a site of active star formation (Figure a). To probe the star formation processes, high-resolution and high-sensitivity near-infrared and mid-infrared data from the James Webb Space Telescope (JWST) are employed toward the Pillar IV and an ionized knot HH 216 in M16 (Figure a). Pillar IV is known to host a Class I protostar that drives a bipolar outflow. The outflow has produced the bow shock, HH 216, which is associated with the red-shifted outflow lobe. HH 216 is traced with the 4.05 micron Br-alpha and the radio continuum emission; however, it is undetected with molecular hydrogen (H2) emission at 4.693 micron (Figure a, b and c). HH 216 seems to be associated with both thermal and non-thermal radio emissions. High-resolution images reveal entangled ionized structures (below 3000 AU) of HH 216 (Figure b). The JWST images (resolution ~0.07-0.7 arcsec) reveal the protostar as a single, isolated object (below 1000 AU; see a circle in Figures d and e). New knots in 4.693 micron H2 emission are detected and are mainly found on Pillar IV's northern side (Figure d). This particular result supports the previously proposed episodic accretion in the powering source of HH 216. One part of the ionized jet (extent ~0.16 pc) is discovered on the southern side of the driving source (Figure e). Based on the analysis of the molecular line data, observational signposts of cloud-cloud collision (or interacting clouds) towards Pillar IV are investigated. Overall, our results suggest that the interaction of molecular cloud components around 23 and 26 km/s might have influenced star formation activity in Pillar IV.



Source/Reference of the Work: *https://doi.org/10.1093/mnras/stae150*

a) JWST F444W/F335M map of M16. Four Pillars and HH 216 are labelled. b) A zoomed-in view of HH 216 using the HST F657N image. c) A zoomed-in view of HH 216 using the 4.89 GHz radio continuum emission map. d) A zoomed-in view of Pillar IV using the JWST F470N-F444W image. Several H2 knots are labelled. e) A zoomed-in view of Pillar IV using the JWST F444W/F335M image. A contour (in cyan) highlights an elongated emission feature traced in the F444W/F335M image. The inset is a three-colour composite map made using the F1500W (in red), F1130W (in green), and F770W (in blue) images. A circle shows the location of the protostar.

The Author

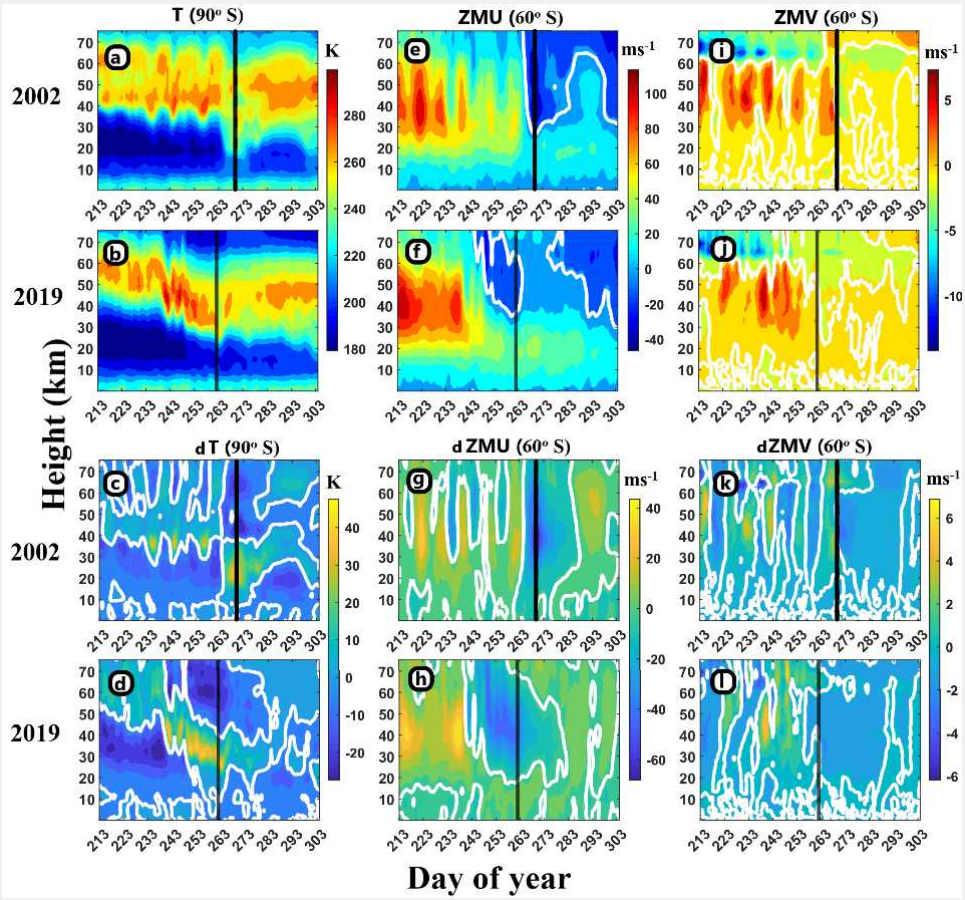
G. Mitra

Impact of sudden stratospheric warming on middle atmospheric circulation in the southern hemisphere: A comparative study

(***G. Mitra*** *and A. Guharay)*

Sudden stratospheric warming (SSW) is an extreme meteorological event where the polar vortex is disrupted, leading to a significant increase in temperature. This usually happens more in the Northern Hemisphere than in the Southern Hemisphere (SH). However, in September 2002 and 2019, rare SSW events occurred in the SH around the spring equinox, a seasonal transition from late winter to early spring. The study compares middle atmospheric circulation during rare SH SSWs in 2002 and 2019. By removing seasonal effects, it focuses solely on the warming's impact on global circulation. The deseasoned winds show noticeable easterly influences in the lower altitudes around the peak warming day. Early easterly winds in the extratropical stratosphere suggest a possible tropical precursor to SSW. The upper mesospheric wind is dominated by seasonal transition, but deseasoned winds reveal warming's effects as easterly and equatorward forces. Interestingly, although the 2019 SSW is a minor event, it caused noticeable shifts in global circulation patterns. Overall, the study provides valuable insights into the impact of SH SSWs on middle atmospheric circulation.

Source/Reference of the Work: https://doi.org/10.1016/j.jastp.2024.106173



Time-height section of (a) T at 90 °S, (e) ZMU at 60 °S, and (i) ZMV at 60 °S during 2002 observational days and (b) T at 90 °S, (f) ZMU at 60 °S, and (j) ZMV at 60 °S during 2019 observational days. Same for (c) dT at 90 °S, (g) dZMU at 60 °S, and (k) dZMV at 60 °S during 2002 observational days and (d) dT at 90 °S, (h) dZMU at 60 °S, and (l) dZMV at 60 °S during 2019 observational days. The solid vertical line represents the PWD. The white bold curves represent zero values in all the plots. Please note the change of scale in the colorbars corresponding to each subplot while comparing. Also, consider the difference in colorbar used to represent actual and deseasoned variability.

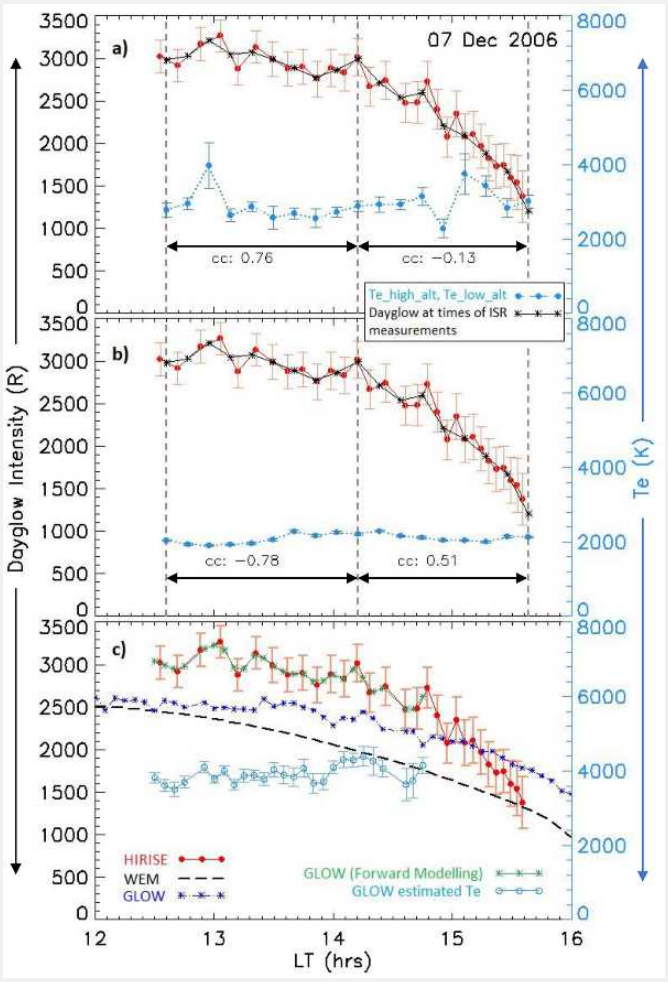
The Author

Kshitiz Upadhyay

First Daytime Red-Line Emission Measurements of the Stable Auroral Red (SAR) Arcs

(***Kshitiz Upadhyay*** *and Duggirala Pallamraju)*

Stable auroral red (SAR) arcs are atomic oxygen (OI) monochromatic red line emissions at 630.0 nm wavelength formed by $O(^1D) \Rightarrow O(^3P)$ transition. These are latitudinally narrow and longitudinally elongated channel of enhanced 630.0 nm brightness that typically occur in the Earth's mid-latitude upper atmosphere during geomagnetic disturbances. SAR arcs are optical manifestation of Magnetosphere-Ionosphere (M-I) coupling that can take place during geomagnetic disturbances and are driven by the precipitation of low-energy particles (<10 eV) from near plasmapause region into the topside ionosphere through downward heat conduction. SAR arcs are faint emissions and mostly observed in the nighttime for dark sky conditions. Due to the presence of strong sunlight in the daytime, their optical investigations eluded the attention of the researchers so far. In this work, we have used the OI 630.0 nm emissions enabled using the High-Resolution Imaging Echelle Spectrograph (HIRISE) from Boston, a mid-latitude location, to make the first daytime redline emission measurements of the SAR arcs in the daytime. It was seen that during a geomagnetically disturbed day, the measured emissions were significantly exceeding the model estimates. To identify the cause for such enhanced emissions, complementary measurements of the local ionospheric parameters from a collocated Millstone Hill incoherent scatter radar (ISR) and space-based in-situ measurements of plasma parameters were also investigated. These investigations confirmed the observed enhancement in red line emissions subjected to larger Te and to be associated with daytime SAR arc. Not only did this study report the first ground-based detection of the SAR arc, but also by forward modelling studies, the electron temperatures required to cause such enhancement in emissions in the daytime has been estimated. These values of electron temperatures have been estimated to be ranging from 3500 – 4400 K during this SAR arc event. These results provide further insights to investigate the underlying mechanisms of M-I coupling responsible for the dayside formation of SAR arcs.



Source/Reference of the Work: *https://doi.org/10.1029/2023GL106292*

HIRISE measured daytime 630.0 nm emissions on 7 December, 2006 are shown in red in panel-a, b, and c. These measured emissions interpolated at the times of ISR measurements (black-line) were compared with the ISR measured Te at ~520 (Te_high_alt) and 320 km (Te_low_alt) altitudes for different times, as shown by sky-blue lines in panel-a and b, respectively. A strong positive correlation of 0.76 was observed between high altitude Te and enhanced emission intensities during 12.6 and 14.2 LT period. This duration reflects the presence of SAR arc in daytime. The panel-c shows the WEM (black-dashed) and GLOW model (blue-asterisk) calculated emissions along with the observed emissions. Further, the forward modelling estimated emissions and Te values are shown by green-asterisks and sky-blue open circles, respectively, as associated with the observed SAR arc intensities.

The Author

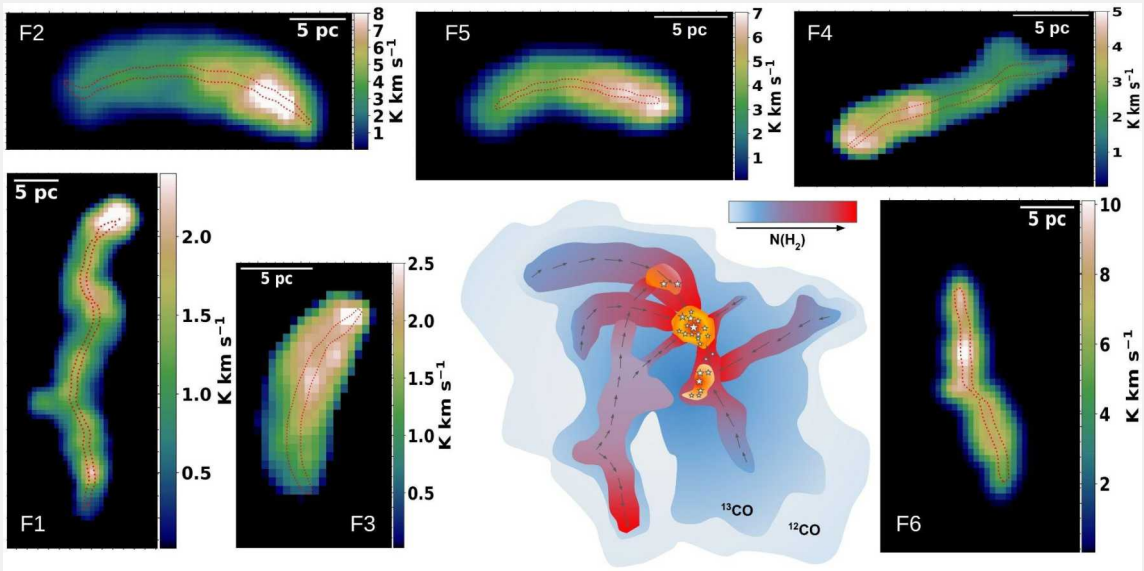
Vineet Rawat

Cluster formation at the nexus of filamentary flows in the giant molecular cloud G148.24+00.41

(***Vineet Rawat***, *M. R. Samal, D. L. Walker, D. K. Ojha, A. Tej, A. Zavagno, C. P. Zhang, Davide Elia, S. Dutta, J. Jose, C. Eswaraiah, and E. Sharma)*

A group of stars that are gravitationally bound to one another is called a star cluster. In the vast expanses of our galaxy, intricate processes shape the birth and evolution of stellar clusters. Picture long, massive threads of gas and dust weaving through the cosmos like celestial highways, leading straight to the heart of a giant cloud. These threads are popularly known as filaments. Filamentary flows toward the centre of molecular clouds have been recognized as a crucial process in the formation and evolution of stellar clusters. In this paper, we present a comprehensive observational study that investigates the gas properties and kinematics of the Giant Molecular Cloud G148.24+00.41 in our galaxy using the CO molecular line observations. We find that the cloud is massive (10^5 $M_\odot$) and is one of the most massive clouds of the outer Milky Way Galaxy. We identified six likely filaments in the cloud having length, width, and mass in the range of 14–38 pc, 2.5–4.2 pc, and (1.3–6.9) × 10^3 $M_\odot$, respectively. We find that the filaments are converging towards the central hub of the cloud, and the longitudinal accretion flows along the filaments are in the range of ~ 26–264 $M_\odot$ Myr^{-1}. The cloud has fragmented into seven clumps having mass in the range of ~260–2100 $M_\odot$ and an average size of around ~ 1.4 pc, out of which the most massive clump is located at the hub, near the geometric centre of the cloud. Three filaments are found to be directly connected to the massive clump and transferring matter at a rate of ~ 675 $M_\odot$ Myr^{-1}. This central clump hosts a near-infrared cluster, hinting at ongoing star formation processes within it. Our results show the significance of river-like large-scale filamentary accretion flows towards the central region of the collapsing cloud, in supplying the matter necessary to form the central high-mass clump and subsequent stellar cluster.

Source/Reference of the Work: *https://doi.org/10.1093/mnras/stae060*



Intensity maps of the individual filaments of the G148.24+00.41 cloud in ^{13}CO emission. The middle panel shows the cartoon diagram of G148.24+00.41 based on its observed structure and gas properties from CO molecular line data. The diagram shows the gas flow motion from low to high-density regions, shown by black arrows. The substructures show some of the clumps formed in the cloud, out of which the massive clump located at the geometric centre harbours a young cluster. The background colour displays the local density.

The Author

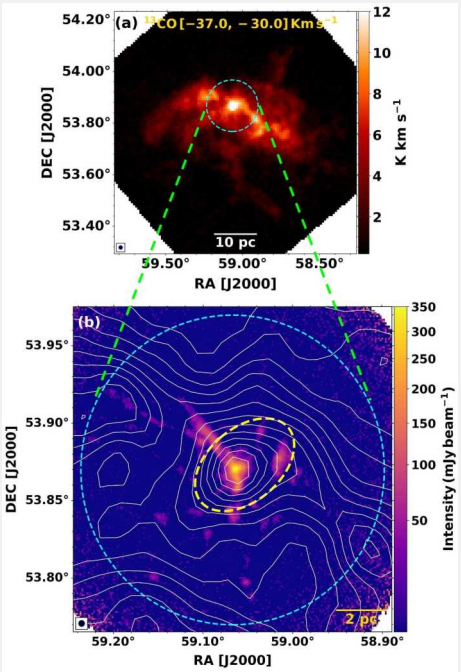
Vineet Rawat

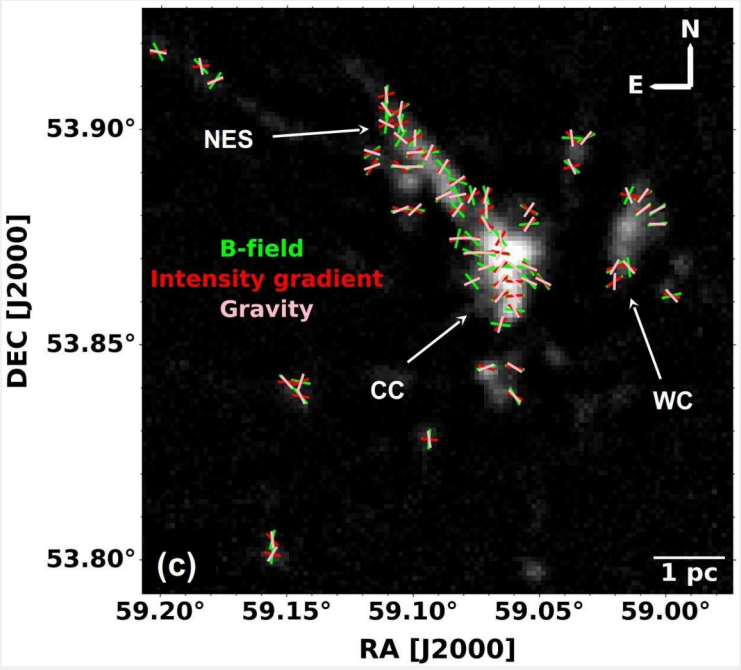
Understanding the relative importance of magnetic field, gravity, and turbulence in star formation at the hub of the giant molecular cloud G148.24+00.41

(***Vineet Rawat***, *M. R. Samal, Chakali Eswaraiah, Jia-Wei Wang, Davide Elia, Sandhyarani Panigrahy, A. Zavagno, R. K. Yadav, D. L. Walker, J. Jose, D. K. Ojha, C. P. Zhang, and S. Dutta)*

The relative importance of magnetic fields, turbulence, and gravity in the early phases of star formation is still not well understood. The plane of sky component of the magnetic field can be traced indirectly using the dust polarization of background starlight. We report the first high-resolution dust polarization observations at 850 μm around the most massive clump, located at the hub of the Giant Molecular Cloud G148.24+00.41, using SCUBA-2/POL-2 at the James Clerk Maxwell Telescope. We find that the degree of polarization decreases steadily towards the denser portion of the cloud with a power-law index of - 0.6. Comparing the intensity gradients and local gravity with the magnetic field orientations, we find that local gravity plays a dominant role in driving the gas collapse as the magnetic field orientations and gravity vectors seem to point towards the dense clumps. A better correlation of intensity gradients with the B-fields tells that matter is following the B-field lines or vice-versa. We also find evidence of U-shaped magnetic field morphology towards a small-scale elongated structure associated with the central clump, hinting at converging accretion flows towards the clump. Our observation has resolved the massive clump into multiple substructures. We study the magnetic field properties of two regions, central clump (CC) and northeastern elongated structure (NES). Using the modified Davis–Chandrasekhar–Fermi method, we determine that the magnetic field strengths of CC and NES are ~24.0 ± 6.0 μG and 20.0 ± 5.0 μG, respectively. The mass-to-flux ratios are found to be magnetically transcritical/supercritical, while the Alfvén Mach number indicates a trans-Alfvénic state in both regions. These results, along with Virial analysis, suggest that at the hub of G148.24+00.41, gravitational energy has an edge over magnetic and kinetic energies.

Source/Reference of the Work: *https://doi.org/10.1093/mnras/stae053*





(a) ^{13}CO gas distribution of G148.24+00.41. (b) The 850 μm total intensity map of the central region of G148.24+00.41 mapped by JCMT SCUBA-2/POL-2, revealing the substructures in the central region. (c) The magnetic field segments (green), intensity gradient orientations (red), and local gravity vectors (pink) are overlaid over the total intensity image at 850 μm.

PRL Ka Amrut Vyakhyaan - 88

88th PRL Ka Amrut Vyakhyaan was delivered by Dr. Thamban Meloth (Director, National Centre for Polar and Ocean Research, Ministry of Earth Sciences, Government of India, Goa), on 24th January, 2024. He delivered the Vyakhyaan on the pressing topic of global warming, titled "Exploring Poles in a Warming World – Indian Endeavours and New Frontiers''.

Global warming and the associated increased loss of polar ice cover are impacting the global climate and environment. The Indian polar endeavour is more than four decades old and currently has two active year-round stations in Antarctica. During the Vyakhyaan, Dr. Meloth gave an overview of the importance of polar regions to our ecosystems, connection between polar and tropical regions, impact of global warming on polar regions and its effect on life on the earth. He highlighted the impact of Arctic climate changes in the Indian monsoon. He discussed India's expedition to the Arctic and Antarctic regions, importance of Himalayan glaciers to Asia, India's research stations and the ongoing research activities in Arctic and Antarctica. He also discussed India's Arctic Policy 2022 to expand India's activities across the Arctic regions in the interest of India's scientific, strategic, geopolitical, and environmental benefit. He concluded the Vyakhyaan, urging for a more active, multidisciplinary, and collaborative engagement between various academic and scientific institutes across the country to better understand the various aspects of polar–tropical teleconnections.

YouTube Link: *https://www.youtube.com/watch?v=zxsNvmk1gmI*

PRL Amrut Rajbhasha Vyakhyaan - 8

"पीआरएल अमृत राजभाषा व्याख्यान (पर्व)" का 8वां व्याख्यान 17 जनवरी, 2024 को हुआ। इस अवसर के प्रख्यात डॉ. सतीश त्रिपाठी भारतीय भूवैज्ञानिक सर्वेक्षण के पूर्व उप महानिदेशक और द सोसाइटी ऑफ अर्थ साइंटिस्ट्स के महासचिव हैं। उन्होंने हिमालय भूविज्ञान और सोन–नर्मदा रेखा क्षेत्र में बड़े पैमाने पर काम किया है। पिछले कुछ वर्षों से वह भारत में भूवैज्ञानिक विरासत संरक्षण को बढ़ावा देने, जियोपार्क के विकास और कानून लाने में लगे हुए हैं।

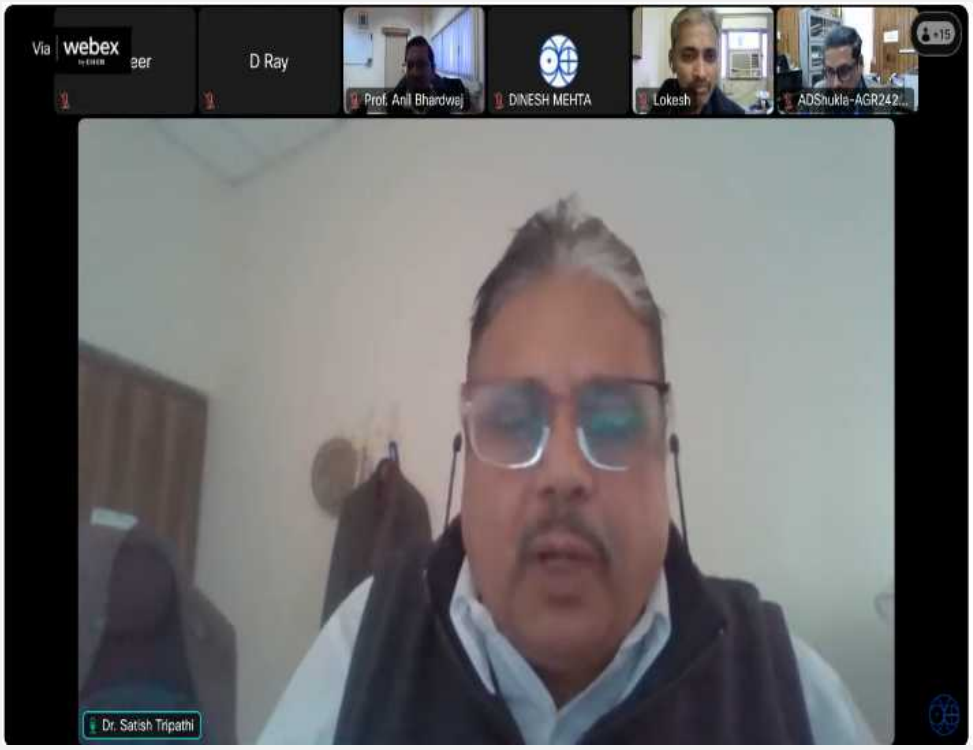
The 8th lecture of "PRL Amrut Rajbhasha Vyakhyaan (PARV)" was scheduled on January 17, 2024. The eminent speaker for the occasion was Dr. Satish Chandra Tripathi, former Deputy Director General of the Geological Survey of India and General Secretary of The Society of Earth Scientists. He has worked extensively in Himalayan geology and the Son-Narmada Line region. For the last few years, he has been engaged in promoting geological heritage conservation in India, development of geoparks and bringing legislation.

व्याख्यान का शीर्षक था, "भू–विरासत संरक्षण की स्थिति और भारत में जियोपार्क विकसित करने की आवश्यकता" |
The lecture was titled "भू–विरासत संरक्षण की स्थिति और भारत में जियोपार्क विकसित करने की आवश्यकता".

व्याख्यान के दौरान डॉ. सतीश चंद्र त्रिपाठी ने बताया कि भारत महान 'भू–विविधता' का प्रतिनिधित्व कर रहा है । वक्ता ने इस बात पर प्रकाश डाला कि पृथ्वी के संसाधन गैर–नवीकरणीय हैं और यदि नष्ट हो जाते हैं, तो इसे दोबारा नहीं बनाया जा सकता है। अतः इनका संरक्षण नितांत आवश्यक है।
During the lecture, Dr. Satish Chandra Tripathi emphasized about India, representing great 'geo-diversity'. The speaker highlighted that the resources of the Earth are non-renewable and if destroyed, it cannot be recreated. Therefore, their conservation is absolutely necessary.

डॉ. सतीश चंद्र त्रिपाठी ने बताया कि, भारत में ऐसे कई भूवैज्ञानिक विरासत क्षेत्र हैं, जो जियोपार्क के रूप में विकसित करने के लिए उपयुक्त हैं और कुछ राज्य सरकारों ने रुचि लेनी शुरू कर दी है, लेकिन यह पर्याप्त नहीं है क्योंकि कई स्थल जीर्ण–शीर्ण स्थिति में हैं और विकास की तेज गति उन्हें पूरी तरह से खत्म कर सकती है। इसलिए, इस बात की तत्काल आवश्यकता है कि हमारे राजनेता और योजनाकार इसके महत्व को समझें और तेजी से कार्य करें।
He further added that, there are many geological heritage areas in India, which are suitable to be developed as geoparks and some state governments have started taking interest, which is not enough, as many sites are in a dilapidated condition and the fast pace of development may destroy completely. Therefore, there is an urgent need that our politicians and planners understand its importance and act swiftly.

आकर्षक प्रश्नोत्तर सत्र में, श्रोता को विषय वस्तु की गहरी समझ हासिल करने और अद्वितीय दृष्टिकोण प्राप्त करने का अवसर मिला।
During an engaging Q&A session, listeners were able to gain deeper understanding of the subject matter and gained unique perspectives.



Youtube Link: *https://www.youtube.com/watch v=XjDYZrdq8Ls&list=PL12xjTGd3ldgQXLe9_O8ygpF92DY2hj6P&index=8*

Glimpses from the event

6th PRL-IAPT Dr. Vikram Sarabhai Lecture

The annual PRL-IAPT Dr. Vikram Sarabhai Lecture is a flagship activity of IAPT RC-07. On the 5th January 2024, the 6th lecture of the series was organized at the K. R. Ramnathan auditorium, Physical Research Laboratory Ahmedabad. The invited speaker was Prof. Nigel Mason OBE, a molecular physicist at the University of Kent, UK. He is very actively involved in frontline researches on astrochemistry and astrobiology and has close links with electron scattering physics community in India. His research has led Prof. Nigel to leadership roles in various international programs of scientific development. He was the President, Europlanet Society, and is the coordinator of Europlanet-2024 Research Infrastructure. Welcoming one and all, Prof. Anil Bhardwaj, Director PRL lauded the lecture activity jointly organized with IAPT every year since 2019.

Prof. Mason gave an insightful lecture on "the physicist in 21st century; Applying fundamental knowledge" to address global challenges. The invited speaker said he had chosen this topic as he was going to address physics teachers who would be nurturing the future physicists. Physics is one of the oldest academic disciplines, perhaps it is the oldest through its inclusion of astronomy and has often been called 'the mother' or 'the king' of sciences.

Physics is often said to be the science that deals with the structure of matter and the interactions between the fundamental constituents of the observable universe. However, this makes it sound a rather abstract and theoretical discipline, whereas physics and physicists are addressing some of the greatest scientific and technological challenges facing humanity and the world today. Physics is integrated with all other sciences. For example, chemistry is rooted in atomic and molecular physics. Most branches of engineering are examples of applied physics. In architecture, physics is at the heart of determining structural stability, acoustics, heating, lighting, and cooling for buildings. Geology relies heavily on physics, including radioactive dating, earthquake analysis, and heat transfer across Earth's surface. Physics is involved in medical diagnostics, such as X-rays and magnetic resonance imaging (MRI). Physics also has many applications in biology for example, physics describes how cells can protect themselves using their cell walls and cell membranes and also plays a key role in understanding the origins of life itself and whether there may be life elsewhere in the universe. While some disciplines, such as biophysics and geophysics, are hybrids of physics and other disciplines.

In this talk, he discussed the physicist of the 21st century and how HE AND SHE will be at the forefront of the greatest scientific challenges and discoveries that await us, from climate change, clean energy, and cancer therapy to humanity's exploration and habitation across our solar system. He emphasised that the world needs physicists, and therefore physics teachers. We have to attract student to the all- important STEM (Science Technology Engineering and Mathematics) theme, and physics is at the core. What is the best age to attract students to physics and Science? It is before 10, he said, and asked, "Who can do it...?!" His answer was.... Teachers...! Prof. Mason concluded his lecture with a touching message to physicists and physics teachers, ...The future of the world and the mankind lies in your hands... and Physics is indeed the oldest science, but 'The best is yet to come'.! In the beginning of the program Prof. K. N. Joshipura introduced the speaker. The lecture was followed by a Q&A session in which IAPT President Prof. Ahluwalia gave his remarks. The program was anchored by Dr. Bhushit Vaishnav.

Book Exhibition by Library & Information Services

The Library organized a book exhibition on 4th and 5th January 2024. There were around 650 Scientific, General, and Hindi books on display by four booksellers from Delhi, Bombay, and Ahmedabad.

The on-campus exhibition helps the staff to browse through many books in their area of interest which are a useful addition to the library collection. The exhibition attracted active participation from research scholars, staff, and faculty members of PRL. 370 books have been recommended by PRL members for the library. The event was well received by research scholars, staff, and faculty members of PRL.

Glimpses from the event

Vikram Discussion on Astrobiology and Astrochemistry

As a part of national science network building initiation of Physical Research Laboratory, the institute has started "Vikram discussions", an annual discussion series to bring together scientists of particular science fields to discuss, debate and design the future course of the community. This discussion series is named after the visionary Dr. Vikram Sarabhai, the founder of PRL and the Indian Space program. As a suitable tribute to the ideals of Dr. Vikram Sarabhai, the newly formed Interdisciplinary Program for Astrobiology and Astrochemistry (IPAA), PRL, organized the first Vikram Discussion (VD-I) on Astrobiology and Astrochemistry at PRL from 5th – 6th January 2024.

This was an effort to bring together astrochemists and astrobiologist from across the country to cater the needs of the current and future Indian Space Programs. As it has been often pointed out, there is indeed a dire need to bring researchers of various fields on a single platform as the interdisciplinary nature of astrobiology & astrochemistry requires the expertise of various fields. To achieve the ambitious goals set by Indian Space Program, researchers across the disciplines have to meet and discuss the current status and the efficient way forward by utilizing the resources and facilities available in the country.

The Vikram Discussions on Astrobiology and Astrochemistry had nearly 15 faculties each from astrobiology and astrochemistry disciplines. Of the 30 faculties, 10 were from universities/colleges and 20 were from Central/ Research institutes. The disciplines covered in the Vikram Discussions spanned from physics, chemistry, biology and geology. In fact, due to the highly interdisciplinary nature of astrobiology and astrochemistry the atomic and molecular physics experiment and computational community interaction with biophysics, biochemistry and bioinformatics was possible due to VD-I.

Based on the outcomes of the two day deliberations and discussions, a detailed vision document outlining the current status, future path and requirements needed to reach the goal for the Indian space community will be brought out which will also be submitted to the Department of Space. One of the key points of the document would be to emphasize the need to find new molecules in space for which a substantial infrastructure and national network development is necessary to have the "first discovery" claims. We have mapped the current planetary analog sites within the country and came up with some new sites, which could be possible Lunar/Martian analogs that need urgent attention. Other points include the need for outreach activity like field visits, workshops and schools for students to build and encourage upcoming astrochemists and astrobiologists.

Glimpses from the event

Outreach Activity

Visit of Students from Suyash College, Rashmi, Chittorgarh district, Rajasthan

A group of students along with faculty from Suyash College, Rashmi, visited Udaipur Solar Observatory on 18/01/2024. Following an introductory lecture on the Sun and solar observations by Ms. Ananya Rawat (SRF), the group visited USO's observational facilities GONG and eCALLISTO in the main campus. The students were informed about different aspects of solar observations and solar activity.

Moments captured during the outreach activity

Martyr's Day

As per the Government of India, Department of Space directive, the 30th January is observed as Martyr's Day in memory of those who sacrificed their lives during struggle for India's freedom. PRL members observed two minutes of silence in memory of freedom fighters on Tuesday, the 30th January, 2024 at their respective work place.

3rd CNIT Division Nukkad – "Chai Pe Byte" on ParamVikram-1000 HPC

The Third, Computer Networking and Information Technology (CNIT) Division's Nukkad – "Chai Pe Byte on ParamVikram-1000 HPC" was held on January 30, 2024 in hybrid mode during 14:45 hrs to 16:00 hrs. There were 30 participants from different divisions/sections attended the session. In the session, 80% discussion was in Hindi and 20% discussion was in the English. The main objective of the initiative is to share the experiences & knowledge, understand users' IT related problems, find their possible solution and strengthen the overall bonding between CNIT Division and PRL colleagues, which in turn will improve the overall functioning of PRL IT services/facilities.

Mr. Jigar Raval welcomed all participants in the third session of CNIT Division Nukkad – 'Chai Pe Byte on ParamVikram-1000 HPC' and briefed the purpose of this initiative and topic Param Vikram-1000. The main objective of the 2nd User Interactive meet was to share the experiences & knowledge, understand users' problems (if any) of HPC and help to resolve them. Additionally, the aim was to motivate & raise awareness among new users to utilize available High Performance Computing Facilities of PRL, which in turn will improve the effective and efficient utilization of the Param Vikram-1000 HPC.

Mr. Vaibhav Rathore, Sci./Engg.-SD, CNIT, explained how to use Conda on Param Vikram-1000 HPC to run application and overcome the library dependencies, which are required for running the application. The Conda has been installed as a module so all the HPC user need not to install in their home directory. However, for any specific need, they can still install in their home directory. All the participants have shared their views and given valuable feedback on Param Vikram-1000 HPC. All the participants actively participated in the session and appreciated the new initiative of CNIT.

Prof. Bijaya Sahoo briefed about the key role of HPC user in effective and efficient utilization of our HPC facility. He also emphasized the importance of writing parallel programme for better efficient utilization of memory and processing power of the HPC system.

CNIT team sincerely thank Director, PRL, for his constant guidance and motivation to initiate such activities in different IT verticals. We thank Dean, PRL and Registrar, PRL for their support. We thank Prof. Bijaya Sahoo, Prof. Varun Sheel and Prof. Namit Mahajan for their guidance and support in all the IT related activities and projects. From the bottom our hearts, we thank all the participants who enthusiastically participated, provided their valuable feedback and encouraged us to conduct similar events in future. We also thank all the PRL users for their cooperation and help. The detailed report of the session is available on CNIT Division Website, accessible within PRL LAN.

URL: *https://www.prl.res.in/prl-eng/cc/intranet/chaipebyte*

Republic Day Celebration at PRL – 26 January 2024

Republic Day marks the adoption of the constitution of India. It is a day of national pride. The 75th republic day was celebrated on friday, 26th January, 2024, at PRL Thaltej campus. Dr. Anil Bhardwaj, director, PRL hoisted the national flag followed by the national anthem.

In his address to PRL family, the director briefed about the various events, activities, achievements, honours etc. acquired by PRL during the year. As per the practice in vogue, 3 (three) merit awards were given to the CISF. Service awards to two PRL members, who have completed 25 years of services in PRL, were also presented. Followed by this, the children of PRL staff who had secured highest marks in hindi subject in 10th standard in the year 2023 were awarded. Winners of essay competition held during vigilance awareness week were also felicitated. To mark the occasion, tri-color balloons were released by kids and PRL family members. Tree-plantation was done by the newly joined PRL members, would-be-retirees of the year and other PRL members at open ground of the campus.

After that, the football tournament's final match between astronomy & astrophysics division and planetary science division was held, which was enjoyed by spectators.

Moments captured from the event

PRL Football Tournament 2024

The PRL Football tournament was organised between 3rd January and 26th January 2024. There were a total of 6 teams: 1) Atomic, Molecular and Optical Physics; 2) Theoretical Physics & Admin; 3) Planetary Sciences division; 4) Astronomy and Astrophysics; 5) Space and Atmospheric Sciences division; and 6) Geosciences division and services. The tournament was played in a round-robin league, with each team facing each other once. The league's top team entered directly into the finals, with second-place and third-place teams playing an eliminator to reach the finals.

The tournament was inaugurated by Director PRL on 3rd January 2024, with an exhibition match between Director VI and Dean VI. The exhibition match shield was presented to Director VI, who won the match 3-2. The inauguration ceremony included the team introduction, ceremonial cake-cutting and exhibition trophy unveiling.
The league stage standings are as below in the table:

Team	Played	Wins	Loses	Draw	Points
Astronomy and Astrophysics	5	3	0	2	11
Planetary Sciences	5	3	1	1	10
Space and Atmospheric Sciences	5	3	2	0	9
Atomic, Molecular and Optical Physics	5	2	2	1	7
Theoretical Physics & Admin	5	1	3	1	4
Geosciences and services	5	0	4	1	1

In the knockout stages, **Space and Atmospheric Sciences** and **Planetary Sciences** played the eliminator, with **Planetary Sciences** winning 3-0.

The final of the tournament was played on 26th January 2024 after the Republic Day celebrations. The finals were inaugurated by felicitation of dignitaries by the organising team, the referees, and the finalists. Director, PRL presented the match ball to the match officials. The final of the tournament was played between the Astronomy division and Planetary Sciences Division. The match was drawn 2-2 in regular and extra time. Astronomy and Astrophysics won the match in penalties 3-2. After the final whistle, Director, PRL and Dean, PRL chaired the prize distribution ceremony. The ground staff were rewarded with contributions from team members as an appreciation for their work. Match referees were felicitated. Astronomy and Astrophysics Division was presented with the winning trophy, followed by high tea. As listed below, the various awardees were rewarded for their contribution during the tournament.

1. **Player of the Tournament:** Dr Arvind Singh Rajpurohit (A&A)
2. **Golden Boot:** Dr Aravind K (A&A)
3. **Goalie of the Tournament:** Shri. Maanyash Jain (SPASC)
4. **Organiser's Fan of the Tournament:** Shri. Tinkal Ladiya and Dr. Akansksha Khandelwal
5. **Emerging Player of the Tournament:** C Vaishnava (A&A)

The organising committee expresses gratitude for the audience's active involvement, participating teams, referees, purchase, CMG, PRL Dispensar, and Canteen Services for making this tournament successful. The organising committee is also thankful to the CMG for installing the lights on the ground for the tournament. Thanks are due to the Director of PRL, the Dean of PRL, and the Registrar of PRL for supporting the tournament and gracing with their presence at the inauguration and finals.

Moments captured from the football tournament

PRL Monthly Publications Digest (January 2024)

Astronomy & Astrophysics Division [3]

1. A. Jana, D. Chatterjee, H. K. Chang, Sachindra Naik, S. Mondal, 2024, Spectral Properties of GX 339-4 in the Intermediate State Using AstroSat Observation, Monthly Notices of the Royal Astronomical Society, 527, 2128-2138, Date of Publication: 01/01/2024.

2. Dewangan, Lokesh Kumar; Jadhav, O. R.; Maity, A. K.; Bhadari, N. K.; Sharma, Saurabh; Padovani, M.; Baug, T. ; Mayya, Y. D.; Pandey, Rakesh, 2024, Deciphering the Hidden Structures of HH 216 and Pillar IV in M16: Results from JWST and HST, Monthly Notices of the Royal Astronomical Society,https://doi.org/10.1093/mnras/stae150, Date of Publication: 15/01/2024.

3. Vineet Ojha, Veeresh Singh, M. Berton, E. Järvelä, 2024, Intra-night optical variability of peculiar narrow-line Seyfert 1 galaxies with enigmatic jet behavior, Monthly Notices of the Royal Astronomical Society, Letters, Volume 529, Issue 1, pp. L108-L114, Date of Publication: 10/01/2024.

Atomic Molecular and Optical Physics Division [1]

1. Shruti Sajwan, Manisha Sharma, Santosh Kachhap, Malika Singhal, Akhilesh Kumar Singh, Mohit Tyagi, Partha Sarathi Sarkar, Naveen Chauhan, Sunil Kumar Singh , 2024, Structural and Optical Properties of Zn2.95Ga2-xSnO8:xCr3+: An excellent X-ray Charging-Based Persistent Phosphor, Journal of Alloys and Compounds, Date of Publication: 03/01/2024.

Geosciences Division [3]

1. Devaprasad, M., Rastogi, N., Satish, R., Patel, A., Dabhi, A., Shivam, A., Bhushan, R., and Meena, R., 2024, Dual carbon isotope-based brown carbon aerosol characteristics at a high-altitude site in the northeastern Himalayas: Role of biomass burning, Science of The Total Environment, Date of Publication: 01/01/2024.

2. A. Bohra, Amzad H. Laskar, M. Mehta, A. Ambili, A. K. Pandey, 2024, Late Quaternary palaeoclimatic records from the Indian Himalaya and Ganga foreland basin: Assessment on current understanding and future prospective, Elsevier logo Journals & Books Go to journal home page - Quaternary Science Advances Quaternary Science Advances, Date of Publication: 01/01/2024.

3. Amzad H. Laskar, T. F. Yui, M. C. Liang, 2024, Carbonate clumped isotopes and blocking temperatures of marbles from the Backbone Range, Taiwan, Journal of Asian Earth Sciences, Date of Publication: 01/01/2024.

Space & Atmospheric Sciences Division [2]

1. Kshitiz Upadhyay, Duggirala Pallamraju, 2024, First Daytime Red-Line Emission Measurements of the Stable Auroral Red (SAR) Arcs, Geophysical Research Letters, Date of Publication: 31/01/2024.

2. G. Mitra, and A. Guharay , 2024, Impact of sudden stratospheric warming on middle atmospheric circulation in the southern hemisphere: A comparative study, Journal of Atmospheric and Solar-Terrestrial Physics, Date of Publication: 12/01/2024.

Planetary Sciences Division [1]

1. Ramakant R. Mahajan, 2024, Chondrules from the ordinary chondrite Itawa Bhopji (L3-5): Noble gases and nitrogen, Planetary and Space Science, Date of Publication: 11/01/2024.

Theoretical Physics Division [3]

1. Anjan S. Joshipura and Ketan M. Patel, 2024, Soft supersymmetry breaking as the sole origin of neutrino masses and lepton number violation, JHEP 01 (2024) 135, Date of Publication: 23/01/2024.

2. Partha Konar, Vishal S. Ngairangbam, Michael Spannowsky, 2024, Hypergraphs in LHC phenomenology — the next frontier of IRC-safe feature extraction, Journal of High Energy Physics (JHEP) 01, 113 (2024), Date of Publication: 19/01/2024.

3. Ketan M. Patel, Saurabh K. Shukla, 2024, Quantum corrections and the minimal Yukawa sector of SU(5), Phys.Rev.D 109 (2024) 1, 015007, Date of Publication: 09/01/2024.

Awards & Honours

(1) **Mr. Arijit Roy**, PDF, Atomic, Molecular and Optical Physics Division of PRL has received **The Best Poster Award in the "60th Annual Convention of Chemists (60th ACC 2023) "** held at IIT-Delhi during 20-21 December 2023.

(2) **Dr. Neeraj Rastogi**, Professor, Geosciences Division of PRL, has been selected for support by the **Science and Engineering Research Board (SERB) for Core Research Grant (CRG)**.

(3) **Dr. J. P. Pabari**, Associate Professor, Planetary Sciences Division of PRL, has been selected for support by the **Science and Engineering Research Board (SERB) for Core Research Grant (CRG)**.

(4) **Committee Of Space Research (COSPAR)** has decided to present **Dr. Sovan Saha**, PDF, Space and Atmospheric Sciences Division of PRL with an **Outstanding Paper Award for the Young Scientists 2022**

(5) **Dr. Jayesh P. Pabari,** Associate Professor, Planetary Sciences Division of PRL has been **invited to join as a member of Research Advisory Council (RAC)**.

(6) **Dr. Bijaya Sahoo**, Senior Professor, Atomic, Molecular and Optical Physics Division of PRL, has been selected for support by the **Science and Engineering Research Board (SERB) for Core Research Grant (CRG)**.

Visitors

1. **Prof. Nigel John Mason** of University of Kent, Kent, U.K. visited PRL from 04.01.2024 to 08.01.2024 in connection with scientific discussion with scientists and research scholars in PRL, Ahmedabad.

2. **Prof. Sumit Roy** from National Science Foundation, USA visited PRL, Ahmedabad on 23.01.2024 in connection with scientific discussion in the field of quantum optics and communication for future collaboration.

3. **Mr. Said Hmiddouch** from University of Liege, Belgium visiting PRL, Ahmedabad and Infra-Red Observatory, Mount Abu during the period from 22.01.2024 to 03.03.2024 in connection with collaborative works under BIPASS on Indo-Belgium project.

Hearty welcome to our new members

NAME: Ms. Tvisha R. Kapadia

DESIGNATION: Junior Research Fellow-DST-Inspire

DATE OF JOINING: 08.01.2024

DIVISION/AREA: Planetary Science Division

NAME: Mr. Deependra Singh

DESIGNATION: Junior Research Fellow-DST-Inspire

DATE OF JOINING: 15.01.2024

DIVISION/AREA: Geoscience Division

NAME: Dr. Ruchita Shah

DESIGNATION: Post Doctoral Fellow

DATE OF JOINING: 16.01.2024

DIVISION/AREA: Space & Atmospheric Science Division

NAME: Mr. Kava Harsh Vimalbhai

DESIGNATION: Junior Research Fellow-DST-SRG

DATE OF JOINING: 30.01.2024

DIVISION/AREA: Space & Atmospheric Science Division

NAME: Dr. Ajay Dev Asokan

DESIGNATION: Post Doctoral Fellow

DATE OF JOINING: 01.02.2024

DIVISION/AREA: Geoscience Division

Obituary

Name of the employee	Shri A. R. Gupta
Designation at the time of superannuation	Engineer-SD
Date of Birth	09.07.1946
Date of Joining PRL	19.10.1970
Date of Superannuation	31.07.2006

Teary Eyes for our Departed Member

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