



*Newsletter of the Physical Research Laboratory*

# THE SPECTRUM



Image of the Month

**Vikram Sarabhai Space Cup 2023**



*May 2023 Issue*

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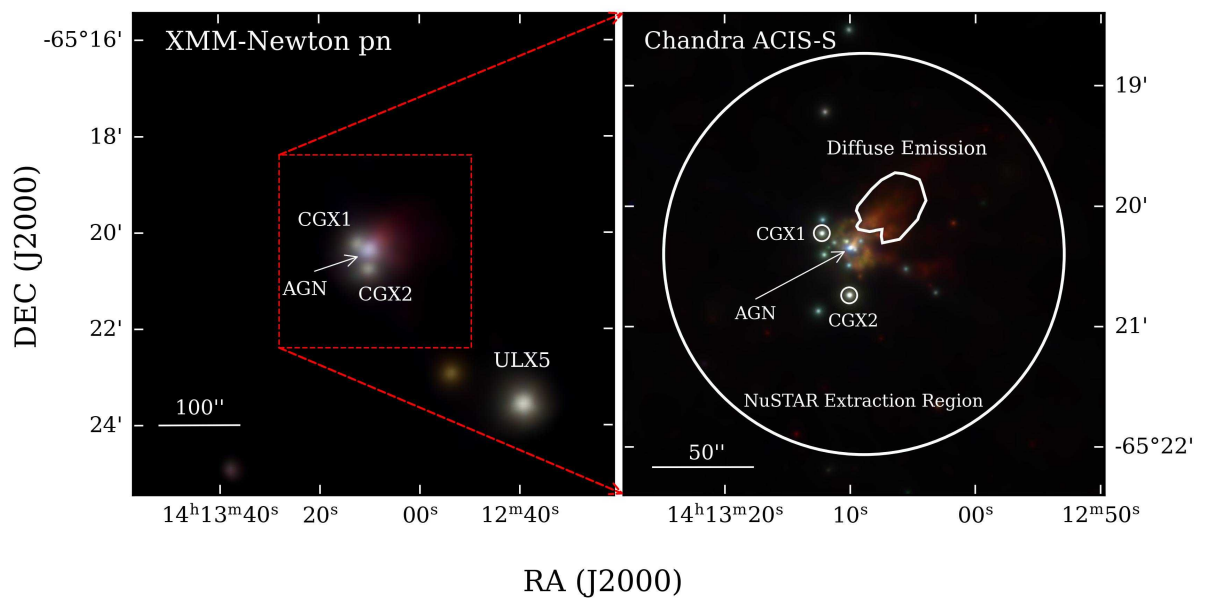
## Multi-epoch hard X-ray view of Compton-thick AGN in Circinus Galaxy

(**Abhijit Kayal**, Veeresh Singh, Claudio Ricci, N. P. S. Mithun, Santosh Vadawale, Gulab Dewangan, and Poshak Gandhi)

Active Galactic Nuclei (AGNs) are the manifestations of accretion onto the supermassive black holes (SMBHs) hosted in the centres of galaxies. According to the widely accepted unification model, AGNs are obscured by gaseous and dusty circumnuclear material forming an axis-symmetric toroidal structure, popularly known as the torus. However, our understanding of the circumnuclear material in terms of its geometrical shape, structure and its dependence on accretion rate is still debated. X-ray photons emanating from the accretion disk system around SMBH penetrate through the obscuring material, and hence X-ray observations provide an efficient tool to probe the circumnuclear obscuring material.

In our recent work, we performed the multi-epoch broad-band X-ray spectral modelling of a nearby heavily obscured AGN in Circinus galaxy (at a redshift of 0.00145 and a corresponding distance of 4.2 megaparsec). We used our AstroSat observations along with all the available hard X-ray ( $> 10$  keV) observations taken from different telescopes, such as *BeppoSAX*, *Suzaku*, *NuSTAR* at ten different epochs across 22 years from 1998 to 2020. The 3–100 keV broad-band X-ray spectral fittings using physically motivated models infer the presence of a thin torus with a low covering factor of 0.28, viewed nearly edge-on ( $77^\circ - 81^\circ$ ) having Compton-thick line-of-sight column densities ( $N_{\text{H, LOS}} = 4.13\text{--}9.26 \times 10^{24} \text{ cm}^{-2}$ ) in all the epochs. The joint multi-epoch spectral modelling suggests that the overall structure of the torus is likely to remain unchanged. However, we find tentative evidence for the variable line-of-sight column density on timescales ranging from one day to one week to a few years, suggesting a clumpy circumnuclear material located at sub-parsec to tens of parsec scales from SMBH.

**Source/Reference of the Work:** <https://doi.org/10.1093/mnras/stad1216>



**Figure Caption:** (left) The *XMM-Newton* pn image of Circinus in which the AGN and the off-nuclear contaminating sources CGX1, CGX2, and ULX5 are marked. (right) the zoomed-in view of the central region as seen in the sensitive Chandra ACIS-S image of higher resolution obtained from the longest exposure time of 152 ks.

### The Author



Abhijit  
Kayal

## The Author



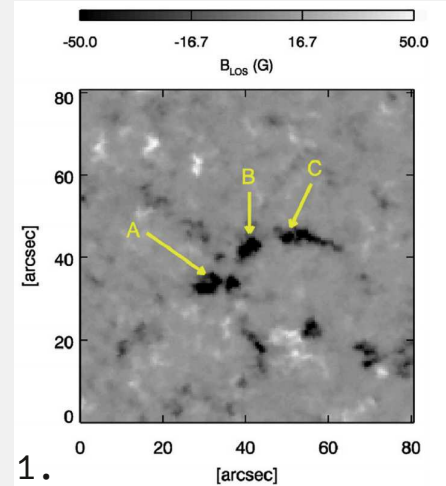
Hirdesh Kumar

## A study of the propagation of magnetoacoustic waves in small-scale magnetic fields using solar photospheric and chromospheric Dopplergrams: HMI/SDO and MAST observations

(Hirdesh Kumar, Brajesh Kumar, S.P. Rajaguru, Shibu K. Mathew, and Ankala Raja Bayanna)

Acoustic waves are stochastically excited inside the convection zone of the Sun and intermittently interact with the background magnetic fields resulting in episodic signals. We investigate the propagation of low-frequency magneto-acoustic waves into the solar chromosphere within small-scale inclined magnetic fields over a quiet-magnetic network region utilizing near-simultaneous photospheric and chromospheric Dopplergrams obtained from the HMI instrument onboard SDO spacecraft and the Multi-Application Solar Telescope (MAST), operational at the Udaipur Solar Observatory, respectively.

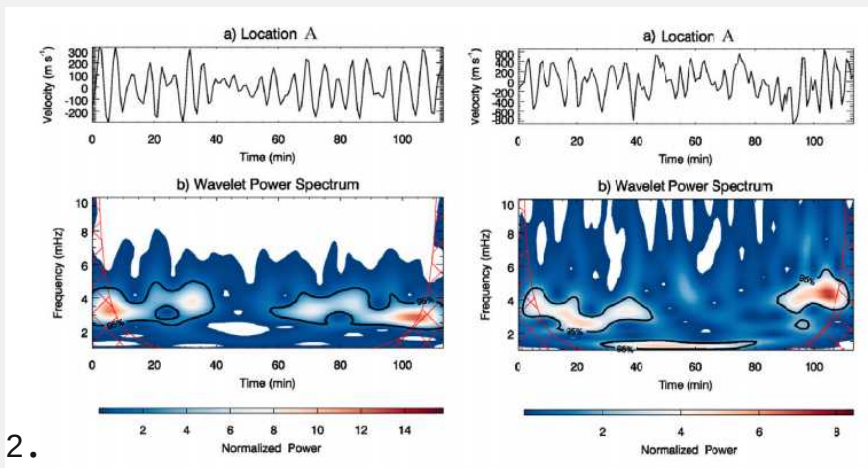
To detect these episodic signals, we apply the wavelet transform technique to the photospheric and chromospheric velocity oscillations in magnetic network regions (c.f. Figure 1). The wavelet power spectrum over photospheric and chromospheric velocity signals show a one-to-one correspondence between the presence of power in the 2.5–4 mHz band (c.f. Figure 2). Further, we notice that power in the 2.5–4 mHz band is not consistently present in the chromospheric wavelet power spectrum despite its presence in the photospheric wavelet power spectrum (c.f. Figure 2). This indicates that leakage of photospheric oscillations (2.5–4 mHz band) into the higher atmosphere is not a continuous process.



**Figure Caption:** Sample map of average of photospheric line-of-sight magnetograms over 112 min duration.

The average phase and coherence spectra estimated from these photospheric and chromospheric velocity oscillations illustrate the propagation of photospheric oscillations (2.5–4 mHz) into the solar chromosphere along the inclined magnetic fields. Additionally, chromospheric power maps estimated from the MAST Dopplergrams also show the presence of high-frequency acoustic halos around relatively high magnetic concentrations, depicting the refraction of high-frequency fast mode waves around  $v_A \approx v_S$  layer in the solar atmosphere.

**Source/Reference of the Work:** <https://doi.org/10.1016/j.jastp.2023.106071>



**Figure Caption:** (left) panel a) shows the temporal evolution of average velocity signals obtained from the photospheric Dopplergrams (HMI/SDO) for the location ‘A’ as shown in Fig.1. Panel (b) shows the Wavelet Power Spectrum (WPS), computed from velocity time series. In the WPS, the solid lines demonstrate regions with the 95% confidence level, and the hatched region indicates the cone of influence. (right): Same as left panel but for chromospheric velocity constructed from MAST observations.

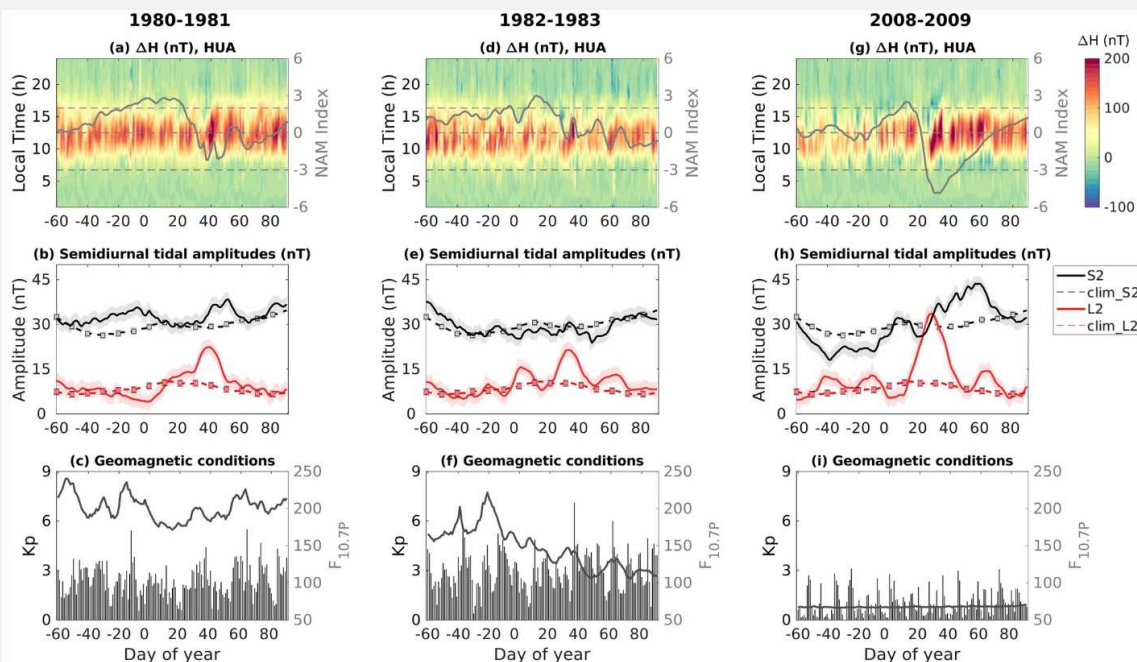
## Impact of strong and weak stratospheric polar vortices on geomagnetic semidiurnal solar and lunar tide

(Sunil Kumar, Tarique A. Siddiqui, Claudia Stolle, Nicholas M. Pedatella, and Duggirala Pallamraju)

The stratospheric polar vortex (SPV) is a band of strong winds that encircle the polar region and gets affected by vertically propagating planetary waves from lower below. This interaction leads to an increase in the stratospheric temperature and a reduction in the eastward winds which is also known as sudden stratospheric warmings (SSW). In the absence of planetary waves, eastward winds increase and the temperature remains low which is associated with the strong SPV. The state of the SPV modulates the atmospheric circulation which causes changes in the spectrum of vertically propagating atmospheric waves.

In this work, we have investigated the impact of the strength of the northern hemispheric SPV on the ionosphere in 34 winters (during 15 December to 1 March) for 41 years (1980-2020). In order to do that, the equatorial electrojet (EEJ) variations, as obtained from Huancayo (12.05° S, 284.67° E; magnetic latitude: 0.6° S) are used. The Northern Annular Mode (NAM) values are used to define the strength of the SPV. The EEJ gets affected by the upward propagating solar and lunar tides which are generated in the lower atmosphere due to heating by solar radiation and gravitational force by the moon, respectively. We have investigated that the solar and lunar semidiurnal tidal amplitudes in the EEJ increase during the weak SPV, whereas, their amplitudes decrease during the strong SPV as can be seen in Figure 1. Our results also reveal that the response of the geomagnetic semidiurnal solar tidal variations to strong and weak SPV conditions is delayed by approximately 10 days while the response of geomagnetic semidiurnal lunar tidal variations does not show a time delay. These results provide observational evidence that along with weak SPV, the strong SPV also have pronounced effects on the equatorial ionosphere.

**Source/Reference of the Work:** <https://doi.org/10.1186/s40623-023-01810-x>



**Figure Caption:** Panels a, d, and g show the local time EEJ variations from 1st November to 31st March for the winters of years 1980–1981, 1982–1983 and 2008–2009, respectively. The solid gray lines in the top panels represent the NAM values, while dashed gray lines correspond to the NAM value of 2 and -3 associated with the reference values for strong and weak SPV, respectively. In panels b, e, and h, the amplitudes of semidiurnal solar (solid black line) tide and its climatology (dashed black line) are shown for the same years as mentioned above. In a similar way, the amplitudes of semidiurnal lunar (solid red line) tide and its climatology (dashed red line) are shown in these figures. Panels c, f, and i show the daily averaged Kp values in black bars and daily  $F_{10.7P}$  levels in solid gray lines.

### The Author



Sunil Kumar

## The Author



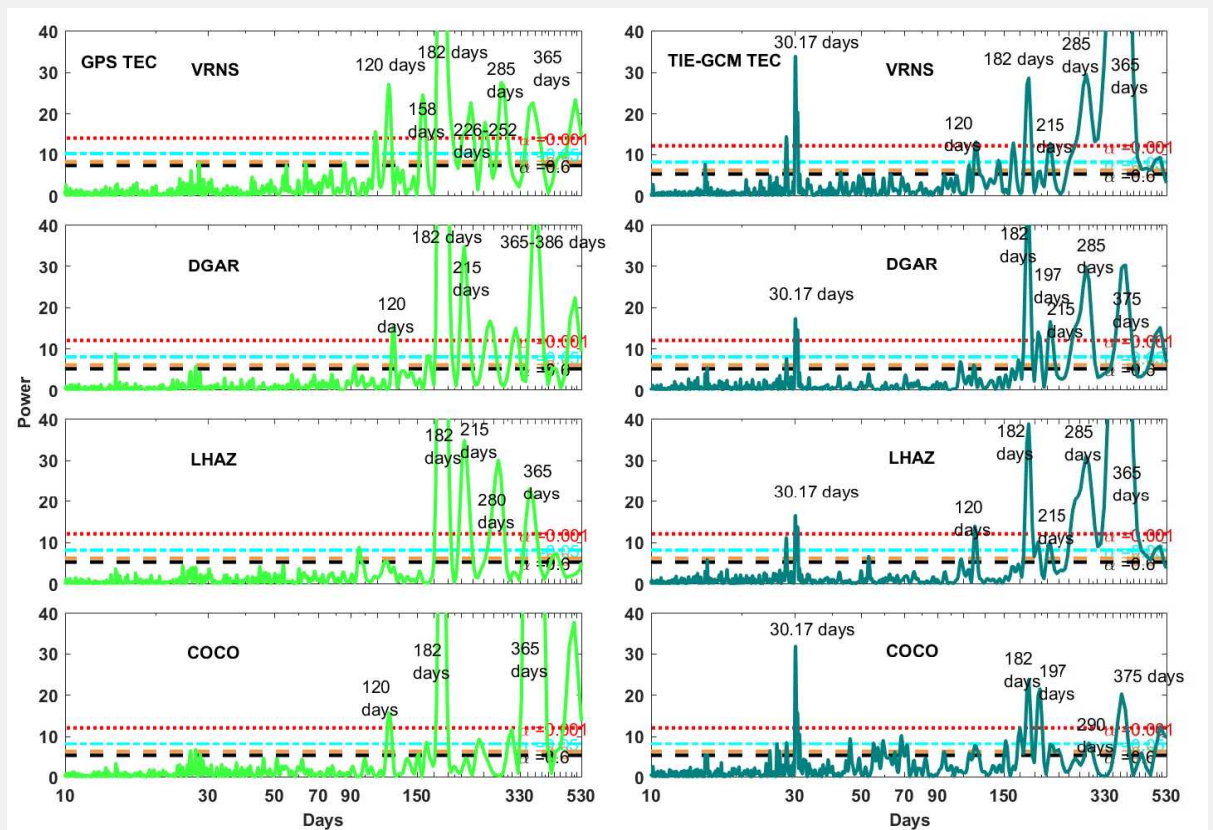
**Sardar Singh Rao**

## Solar Hysteresis Pattern and Spectral Components in TEC Time Series (GPS and TIE-GCM) of the Quadrilaterally Coupled Geomagnetic Conjugate Low-latitude Stations

(**SS Rao**, D. Chakrabarty, and Nandita Srivastava)

Inherent periodicities in Total Electron Content (TEC) time series at pairs of geo-magnetically conjugate land-locked (Varanasi (25.31°N; 82.97°E) and LHAZ (29.65°N; 91.10°E)) and sea-locked (DGAR (7.27°S; 72.37°E) and COCO Island (12.18°S; 96.83°E)) stations are presented. Thermosphere-lonosphere-Electrodynamics General Circulation Model (TIE-GCM) accurately models semi-annual and annual oscillations, but dissimulate seasonal anomaly at southern low-latitudes. Terannual (120-day) and 1.4-year (500-day) periodicities in the TEC time series are observed only at EIA region stations, not at off-crest location LHAZ, and are most likely caused by E x B drift. The wavelet coherence analysis reveals that the Quasi Biannual Oscillations (QBO) in the TEC time series (597-, 773-, and 930-day) have a strong physical affinity with the QBO oscillation of F10.7 flux.

**Source/Reference of the Work:** <https://doi.org/10.1029/2023JA031428>



**Figure Caption:** The periodicities inherent to the daily noontime maximum GPS TEC (left) and TIE-GCM TEC (right) data on applying the Lomb-Scargle periodogram technique are shown.

## The Author



Neeraj Kumari

### Investigation of a small X-ray flaring event in NLS1 galaxy NGC 4051

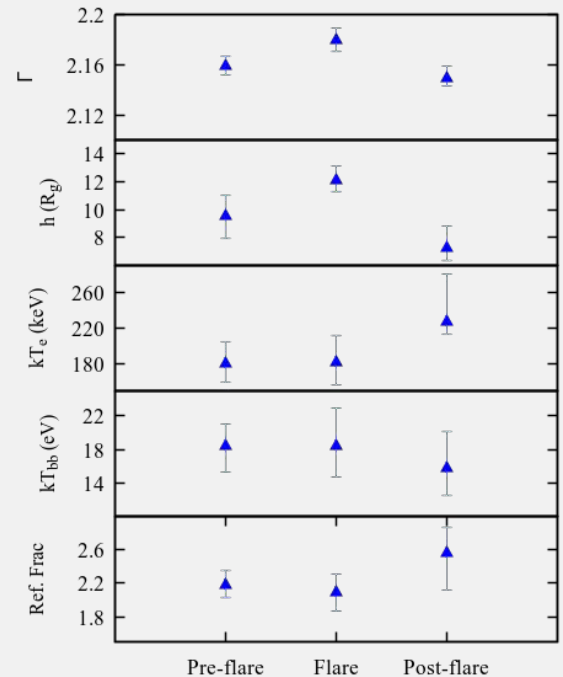
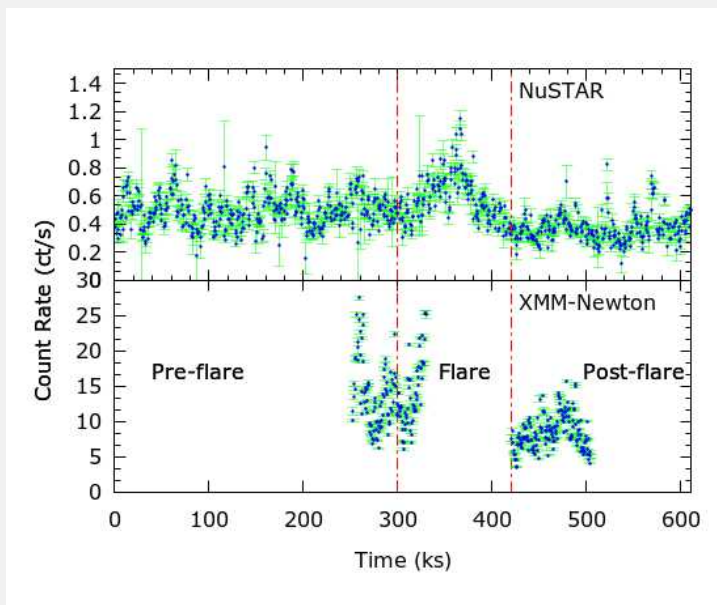
(Neeraj Kumari, Sachindar Naik, Prantik Nandi, Arghajit Jana)

In Active Galactic Nuclei (AGNs), the X-ray emission from the corona is highly variable. Short time scale variability is ubiquitous, with count rate changing by a factor of 2-3 in just few hours. Moreover, AGNs have been seen transitioning from higher to lower flux states corresponding to the transition in the coronal structural changes.

We performed a detailed broad-band spectral and timing analysis of a small flaring event of  $\sim 120$  ks in the narrow-line Seyfert 1 galaxy NGC 4051 using simultaneous *XMM-Newton* and *NuSTAR* observations. The  $\sim 300$  ks long *NuSTAR* observation and the overlapping *XMM-Newton* exposure were segregated into pre-flare, flare, and post-flare segments. During the flare, the *NuSTAR* count rate peaked at 2.5 times the mean count rate before the flare. Using various physical and phenomenological models, we examined the 0.3–50 keV X-ray spectrum, which consists of a primary continuum, reprocessed emission, warm absorber and ultrafast outflows at different time-scales. The mass of the central black hole is estimated to be  $\geq 1.32 \times 10^5 M_{\odot}$  from spectral analysis. The absence of correlation between the flux in the 6–7 keV and 10–50 keV bands suggests different origins of the iron emission line and the Compton hump.

From the spectral analysis, we found that the reflection fraction drops significantly during the flare, accompanied by an increase in the coronal height above the disc. The spectrum became soft during the flare, supporting the ‘softer when brighter’ nature of the source. After the alleviation of the flare, the coronal height drops and the corona heats up. This indicates that there could be inflation of the corona during the flare. We found no significant change in the inner accretion disc or the seed photon temperature. These results suggest that the flaring event occurred due to a change in coronal properties rather than any notable change in the accretion disc.

**Source/Reference of the Work:** <https://doi.org/10.1093/mnras/stad867>



**Figure Caption:** (right) The X-ray lightcurve of NGC 4051 in 3–50 keV and 0.3–10 keV has been shown (left) Variation of the best-fitting parameters is shown for three phases. The photon index ( $\Gamma$ ), coronal height ( $h$ ), reflection fraction ( $R$ ), coronal temperature ( $kT_e$ ) and inner disc temperature ( $kT_{bb}$ ) are obtained from different models.

## The Author



**Srubabati Goswami**

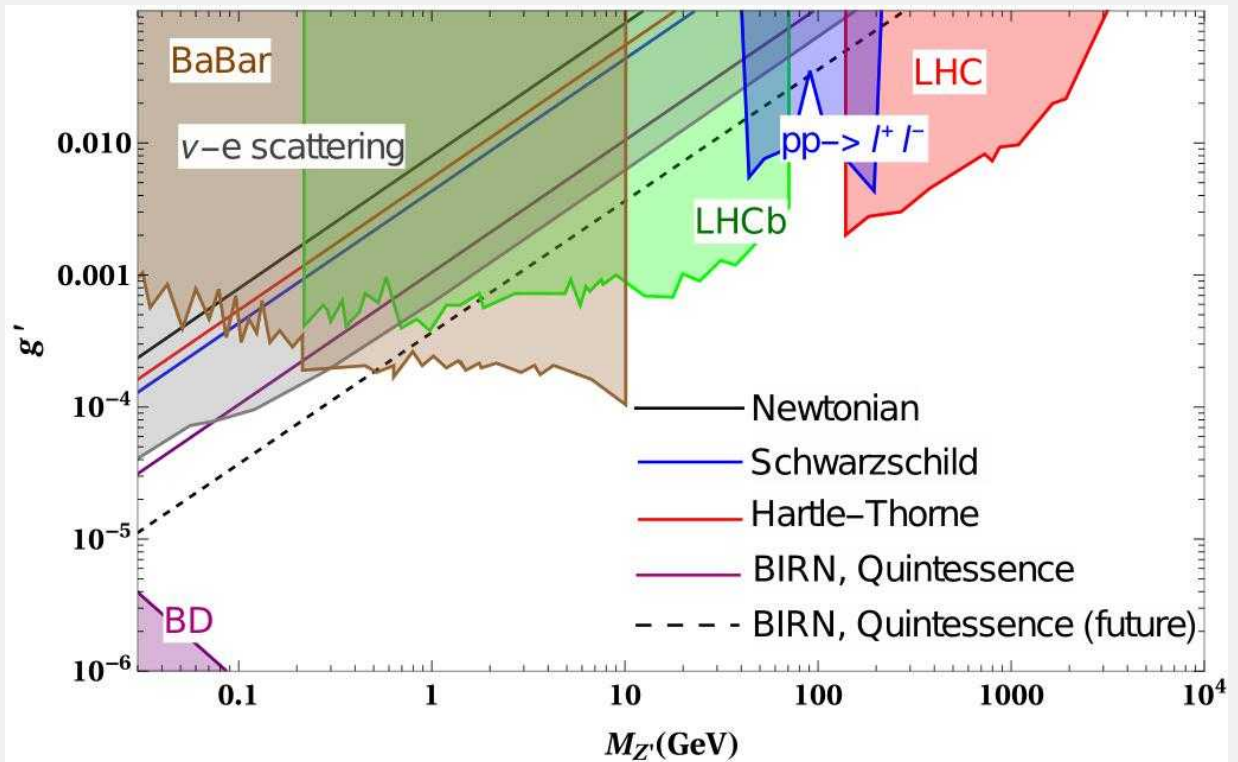
### Neutrino heating in energizing GRB: Effects of new physics

(Tanmay Kumar Poddar, **Srubabati Goswami** and Arvind Kumar Mishra)

The pair annihilation of neutrinos to electron-positron pairs can energize violent stellar explosions such as gamma ray bursts (GRBs). The energy of GRB in this neutrino heating mechanism can be further enhanced by modifying the background spacetime over that of Newtonian spacetime. However, one cannot attain the observed maximum GRB energy. On the other hand, using modified gravity theories or the Quintessence field (an additional scalar field introduced to explain late time expansion of the Universe) as background geometries, the maximum GRB energy can be reached.

We consider an extension of the Standard Model of particle physics, in which there can be new interactions leading to extra contributions to the neutrino pair annihilation process. This new interaction is mediated by a new neutral gauge boson. From the observed energy of GRB, we obtain constraints on the strength of the new interaction in general relativity, different modified gravity and Quintessence models.

**Source/Reference of the Work:** <https://link.springer.com/article/10.1140/epjc/s10052-023-11367-4>



**Figure Caption:** The constraints on the mass and interaction strength of the new gauge boson. The regions above the black, red, blue, and purple lines, corresponding to different spacetime geometries, are excluded. The shaded regions show the constraints from other experiments.



## Predicting Leptonic Charge-Parity Violation through Grand Unification

(Ketan M. Patel)

The fact that our universe is predominantly made up of matter and not antimatter implies the existence of Charge-Parity (CP) violation in the fundamental interactions of elementary particles. In the experiments carried out so far, CP violation is found only in the weak interactions of the quarks. Calculations suggest that it is inadequate to explain the observed matter-antimatter asymmetry. Therefore, it is anticipated that there exists another source of CP violation beyond the Standard Model (SM) of elementary particle physics. While it is easy to hypothesise a new source of CP violation, predicting its magnitude is exceptionally challenging due to the generic nature of complex couplings that arise in the extension of the SM.

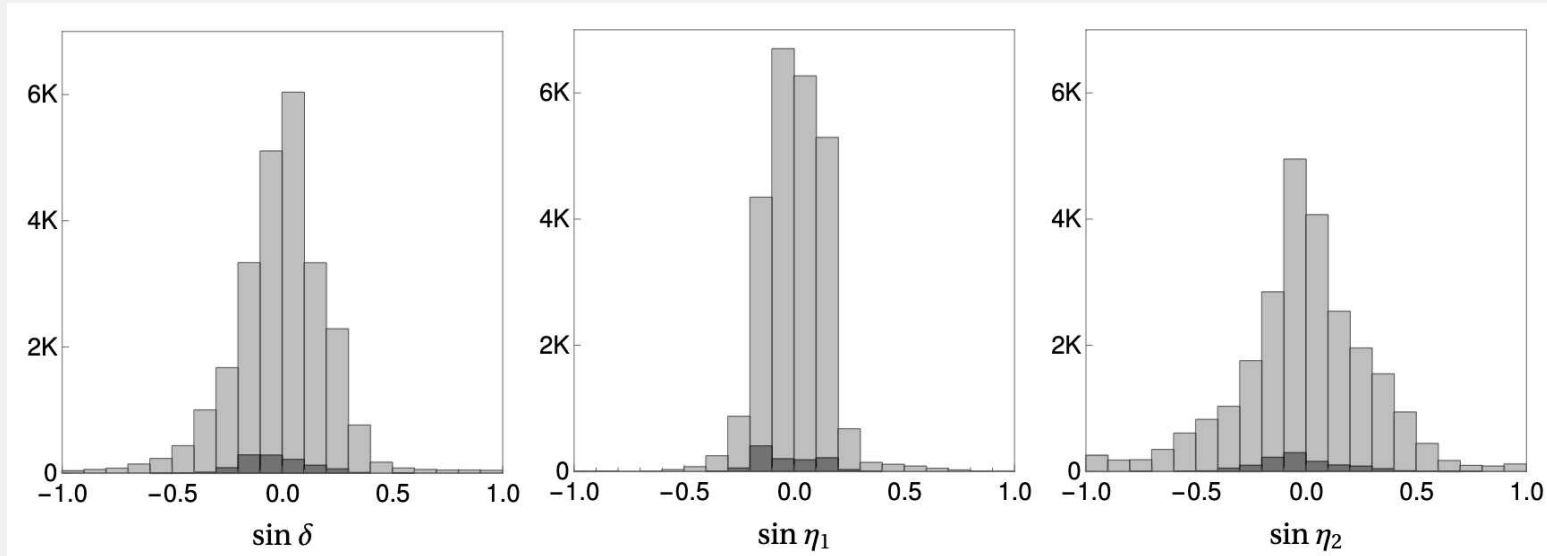
Using the idea of quark-lepton unification offered by the Grand Unified Theories (GUT) and spontaneously broken CP symmetry, it is shown by us in this work that a clear and conclusive prediction for leptonic CP violation is possible. While the CP symmetry controls the phases in new couplings, quark-lepton unification enables a relationship between the observed CP violation in the quark sector with the unknown CP phases in the lepton sector. As a result, a definitive prediction for the latter emerges. The range of predicted values becomes even narrower when the new CP violation is made accountable for the observed matter-antimatter imbalance.

**Source/Reference of the Work:** <https://doi.org/10.1103/PhysRevD.107.075041>

### The Author



Ketan M. Patel



**Figure Caption:** Distributions of predicted values of Leptonic CP phases from minimal SO(10) GUT. The darker bars are values which reproduce correct matter-antimatter asymmetry of the universe.

**The Author**



**Milan K. Mahala**

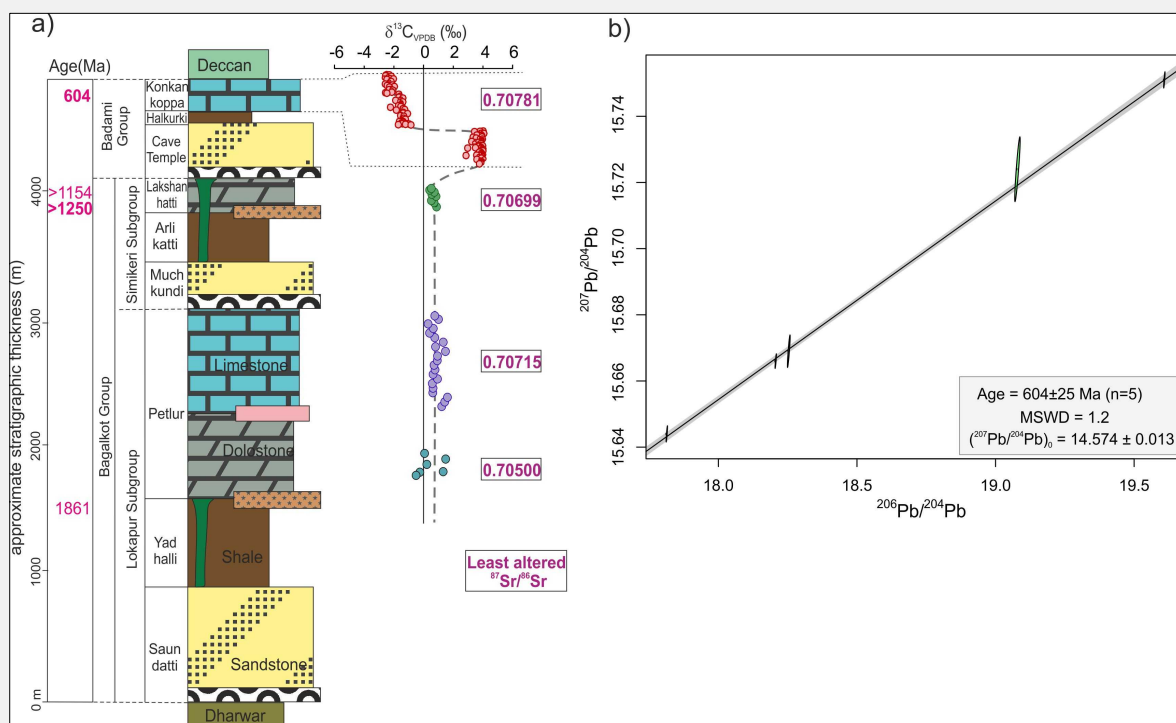
**C-Sr-Pb isotope systematics of the carbonate sequences of Kaladgi Supergroup, India: Implications for basin evolution and correlation with Proterozoic global events**

(Bivin G. George, Jyotiranjana S. Ray, Shilpa Patil Pillai, **Milan K. Mahala**, Sanjeev Kumar, Vivek S. Kale)

Most of our understanding of oceanic and atmospheric chemistry, climate, and biology during the early evolutionary history of the Earth comes from the study of contemporaneous marine carbonate deposits. Indian sedimentary basins of Proterozoic Eon (2500 – 539 Ma) also host a number of marine carbonate formations which can be studied using various geochemical and isotopic tools to unravel such information. The Kaladgi basin of Karnataka is one of the several Indian Proterozoic sedimentary basins.

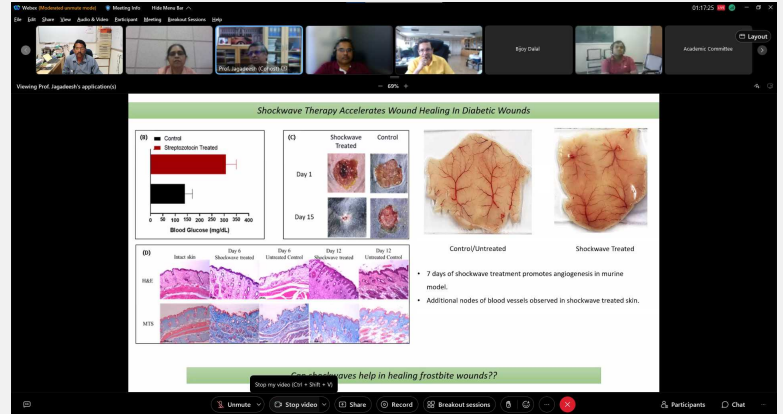
We studied the Limestone and Dolostone formations of the basin using C-O-Sr-Pb isotope systematics to decipher some of the above-mentioned information as well as to constrain the closure of the basin, which had remained equivocal. Our results show that a steady-state organic carbon burial existed during the earlier periods of the Proterozoic, as shown by the consistent  $\delta^{13}\text{C}$  ( $0 \pm 2 \text{‰}$ ) of the older Kaladgi carbonate sequences. In contrast, a dynamic organic carbon burial scenario existed in the later stages of the Proterozoic as evident by the wider  $\delta^{13}\text{C}$  range ( $-2.2$  to  $+3.5 \text{‰}$ ) in the younger Kaladgi sequences. To provide time constraints on the closure of the basin, we dated the youngest Limestone formation of the basin using  $^{206}\text{Pb}$ - $^{207}\text{Pb}$  isochron method and  $^{87}\text{Sr}/^{86}\text{Sr}$  isotope stratigraphy, which provided depositional ages of  $604 \pm 25 \text{ Ma}$  and  $580$ - $625 \text{ Ma}$  respectively. This younger age also refutes the earlier claims that all the Proterozoic basins of peninsular India closed by  $1000 \text{ Ma}$ .

**Source/Reference of the Work:** <https://doi.org/10.1016/j.precamres.2023.107014>



**Figure Caption:** a)  $\delta^{13}\text{C}$  evolution of carbonate formations of the Kaladgi Supergroup; b)  $^{206}\text{Pb}$ - $^{207}\text{Pb}$  isochron of youngest limestone formation (Konkanakoppa)

## PRL Ka Amrut Vyakhyaan



### PKAV-79

**Prof. Gopalan Jagadeesh**, Senior Professor from the Department of Aerospace Engineering Indian Institute of Science, Bangalore delivered a talk on the topic **“Shocking waves - Healing touch!”** on Wednesday, 19 April 2023. He is the Founder Chairman of Centre of Excellence in Hypersonics, in IISc. He is also the Founder Director of Super-Wave Technology Pvt. Ltd – an Initiative with equity participation from IISc to commercialize his discoveries related to industrial applications of shock waves.

### Abstract

The phenomenon of “Shock Waves” has been historically associated with aerospace engineering and in particular with supersonic flight. Shock waves appear in nature, when different elements in a fluid approach one another with a velocity higher than the local speed of sound. These waves are also generated if massive energy dissipation takes place within ultra-short time in events like explosions. A number of methodologies/facilities to generate shock waves of requisite strength have been designed and indigenously built in the Laboratory for Hypersonic and Shockwave Research (LHSR) in Indian Institute of Science (IISc), Bangalore. Over the years, these facilities have facilitated very interesting interdisciplinary research programmes in IISc with participation of several faculty members from physics, chemistry, biology and materials engineering. Some of the novel techniques that were discussed in this talk includes retractable aero-spikes, smart coatings, forward facing jets and concentrated energy deposition for reducing the aerodynamic drag around vehicles flying at hypersonic speeds. Concurrently, utilizing the remarkable ability of shock waves to instantaneously enhance the pressure and temperature in the propagating medium, several innovative shock wave assisted techniques have been developed in LHSR. These include non-intrusive needleless vaccine delivery, cell transformation, Wound healing, bio-film destruction, sandal oil extraction, polyphenol enrichment in tea, metal texture modification, and preservative impregnation in bamboo. A broad overview of the recent Transdisciplinary shock wave research and technology development activities at LHSR were presented in this Colloquium.

*Available online at <https://www.youtube.com/live/A9ESb4fi3Fk>*

## USO/PRL Solar Physics Workshop (USPW-2023)

A three-day USO/PRL Solar Physics Workshop (USPW-2023) on “Multi Scale Phenomena on the Sun: Present Capabilities and Future Challenges” was completed successfully between 03-05 April, 2023 at the Udaipur Solar Observatory. The program was inaugurated by Padma Shri A S Kiran Kumar, Chairman PRL, Council of Management. On this occasion, Prof. Anil Bhardwaj, Director, PRL, greeted all the visiting scientists with his welcome address. He briefed about the purpose of this workshop to bring all the present solar scientists on a single platform for discussion on current solar research topics. The chief guest of the inauguration ceremony, Shri A S Kiran Kumar addressed all the scientists and emphasized on the fact that new dimensions and new results of research can be obtained through scientific observations and information, along with innovative techniques such as artificial intelligence and machine learning. For this purpose, he focused on the necessity for a conducive environment in the country. At the end, he inspired the scientists to prepare the outline of the upcoming solar mission through this workshop.

In the three-day workshop, different researchers from across the country discussed various aspects of solar observations and computer simulations to understand those observations. In the workshop several presentations were made followed by discussions on future space solar missions of India. Focus was put on India’s capabilities to understand various solar phenomena. In the workshop total 23 invited talks, 12 solicited talks and 20 posters were presented, and in total almost 80 participants attended the workshop.

On the concluding day of the Udaipur Solar Physics Workshop on Multi-scale Phenomena on the Sun: Present Capabilities and Future Challenges, the focus was on the upcoming Aditya-L1 payloads: VELC, SUIT, ASPEX, PAPA, and MAG. Various principal and co-principal investigators of these payloads discussed their scientific objective and instrumental capabilities. At the end of the session, intense discussions were made on the prospective observational requirements of the solar physics community. It was decided that the delegates will mutually prepare a vision document within a given time frame which will be submitted to the Director, Physical Research Laboratory. The workshop was concluded by Prof. Anil Bhardwaj, Director, Physical Research Laboratory, advised the solar physics community to organize another workshop, preferably international, in the time between the launch of the Aditya-L1 mission and its insertion in the L1 orbit.



## Bag Distribution to PRL Contractual Workers

**W**ith kind guidance and support of the Director, PRL, the distribution of the school bags and pencil boxes were organized by PRL Reserved Class Employees' Association on various dates as on 27.02.2023 and 27.03.2023 at PRL Main Campus and on 18.04.2023 at PRL Thaltej Campus.

During these events, school bag and Compass Box were distributed to the contractual workers of PRL i.e. daily-wages/ shifting, house-keeping, canteen, horticulture, contractual drivers and contractual security guards.

Dr. Anil Bhardwaj, Director, PRL, Dr. D Pallam Raju, Dean, PRL and Dr. R. D. Deshpande, Registrar, PRL also attended the above events and distributed the school bag and Compass Box to contractual workers.



### Glimpses from the Event

### Celebration of Ambedkar Jayanti

The 132<sup>nd</sup> Birth Anniversary of Bharat Ratna Dr. B R Ambedkar was celebrated at Reserved Class Employees' Association Office at PRL Main Campus on 14.04.2023 (Friday). The programme started with the lighting of Diya.

Dr. Anil Bhardwaj, Director, PRL, Dr. Dr. R D Deshpande, Registrar, Dr. D Pallam Raju, Dean, PRL, PRL, Dr. M G Yadava, Liaison Officer for SC/ST/PWD, Dr. Harish Gadhavi, Liaison Officer for OBC and other members paid floral tribute to the great sculptor of Indian Constitution. Dr. Anil Bhardwaj, Director, PRL spoke about the work of Dr. Ambedkar for upliftment of socially and economically backward class and women empowerment. Dr. R D Deshpande, Registrar, spoke about the dedication and contribution of Dr. Ambedkar to the country. Dr. D Pallam Raju, Dean, PRL spoke about the belief and great vision of the Dr. Ambedkar. Dr. M G Yadava, Liaison Officer for SC/ST/PWD and Dr. Harish Gadhavi, Liaison Officer for OBC also shared their thoughts on the auspicious occasion. The programme was coordinated by PRL Reserved Class Employees' Association.



## Celebration of Ambedkar Jayanti at Udaipur Solar Observatory

On May 04, 2023, as a part of celebration of Dr. B.R. Ambedkar Jayanti a function was organized at Udaipur solar Observatory/Physical Research Laboratory, Udaipur. The said programme was organized in hybrid mode. The programme was organized in physical mode at USO/PRL, Udaipur and members of all three PRL campuses are joined online.

Dr. T C Damor, IPS – 1994 Batch, Ex S.P. – Chhittorgarh, Rajasthan, Ex IG – Anti Corruption Bureau, Ex IG – Udaipur, Ex Vice Chancellor of Rajiv Gandhi Tribal University, Udaipur – (First VC), Udaipur was cordially invited in the program organized on the said occasion. The chief guest Dr. T C Damor also delivered a popular lecture on this occasion. The topic of lecture was - **“Dr. B R Ambedkar's contribution to Nation building”**. The program was coordinated by Dr. Bhuwan Joshi, Professor, USO/PRL. Dr. Ramit Bhattacharyya, Professor, USO/PRL greeted the chief guest with a bouquet of flower. After this, the Director, PRL deliver the inaugural address and Smt. Harsha Parmar, Sr. Project Assistant, PRL introduced the chief guest Dr. T C Damor and informed about his achievements. Chief guest Dr. T C Damor briefly presented the contribution of Dr. B.R. Ambedkar’s in Nation building to the audience in layman language. He also provides a glance of life cycle of Dr. B R Ambedkar and various challenges faced by him. Moreover, he focused on Dr. Ambedkar’s contribution in women empowerment, education for all, land reform etc. which is rarely discussed in the public domain. The lecture was followed by a very useful question and answer session on the above topic, which made the program interesting for the participants. After the interaction session Head, USO has presented a memento to the Chief guest. The program was concluded by Mr. Abhishek, Administrative Officer, USO by giving Vote of Thanks.

On the said occasion after the Guest lecture tree plantation was also done in the garden area near the canteen of Udaipur Solar Observatory by the Honourable Chief Guest and staff members of USO/PRL, Udaipur.



## National Fire Service Week



**N**ational Fire Service Week is observed every year in India during the period from 14th April to 20th April. It is observed as a part to pay homage to those brave Fire Fighters, who sacrificed their lives in line to their duty on 14th April, 1944. Industries observe this day/week as Fire Service Day/Week and conducts Training, Drills and Rehearsals to demonstrate the Preparedness to combat emergencies.

As a part of Fire Service Week and considering the vitality of sensitizing PRL members, a mock drill simulated training on Fire incident/accident scenario was conducted at PRL Main campus on Tuesday, 18th April, 2023.

During the programme, Shri. Ramesh Kumar, Inspector, CISF explained about different types of fire, causes and prevention factors related to fire. He has further narrated about the types of extinguishers used in the premises their applicability as per the type of fire.

The practical demonstration was also given by the CISF team on how to use these extinguishers to control the fire and save the human and materials nearby. A total of 103 PRL staff members have participated in the said programme. The overall programme was interactive and informative. Prof. Anil Bharadwaj, Director, PRL, Prof. R.D. Deshpande, Registrar, PRL, Prof. Ravi Bhushan, Chairman, Safety & Security Committee were present during demonstration. They also addressed the gathering and participation in Demonstration.





## PRL Cricket League (PCL-2023)

**P**hysical Research Laboratory, Ahmedabad has organized the first “Inter Area/Division Cricket Tournament – PRL Cricket League -2023 (PCL-2023)” from 22nd April to 30th April 2023 under the celebrations of Azadi Ka Amrit Mahotsava. A total of seven 7 teams (i.e. PSDN, ASTAS, SPASC, GSDN, AMOPH, THEPH, and [Admin + Services]) participated in this tournament. The tournament was kicked off on 22nd April 2023 by having a brief yet fun-filled Inaugural event followed by a friendly match between the Director's team and Dean's team. The Inaugural event included a cake-cutting event by the Director, PRL, and a cricket jersey felicitation to Dr. Anil Bhardwaj (Director, PRL), Prof.D. Pallamraju (Dean, PRL), and Dr. Ravi Bhushan.

Dr. Ravi Bhushan was also felicitated with the Lifetime Achievement Award for his outstanding vision, dedication, and contribution to PRL sports activities.

Right after the Inaugural Event the Director PRL wished all the participants good luck and encouraged them to play with sportsmanship and then we had a friendly match between the Director's and Dean's Teams. The Director's team came out as the winner of the match.



### Glimpses from the Event

The league and knock-out matches were played from 23rd April to 29th April 2023. The final of the PRL Cricket League was played between SPACE SHARKS (SPASC) and GSDN Thundering Earth on 30th April 2023 in the presence of Prof. Anil Bhardwaj (Director, PRL), Prof. D. Pallamraju (Dean, PRL) and PRL members gathered to witness this exhilarating event. Right before the match, the Director PRL presented the Man of the Match trophies to the individual winners of all the previous matches. The final match was an absolute thriller, filled with drama, excitement, and a nail-biting finish. The game went down to the last ball, with the scores tied and the result had to be decided by conducting a super over. In the end, GSDN Thundering Earth emerged victorious by winning the inaugural PRL Cricket League tournament. We congratulate all the participants & winners and look forward to continuing to support their journeys towards success.

## Vikram Sarabhai Space Cup 2023

The Vikram Sarabhai Space Cup football tournament, organised by the Space Applications Centre, commenced on 15th April 2023 at the prestigious Vikramnagar Football Ground, Vikramnagar Colony. The tournament brought together six prominent teams representing different organisations and institutes, adding an extra layer of competitiveness and prestige to the event. The participating teams included the Physical Research Laboratory, Space Applications Centre A, Space Applications Centre B, Institute of Plasma Research, Indian Institute of Technology Gandhinagar, and the Oil and Natural Gas Corporation. Each team boasted a talented roster of individuals passionate about football and their respective fields of expertise.

The tournament was structured in a round-robin format, where each team could face off against the other teams once. The matches were scheduled on weekends, with matches taking place in the evenings and mornings. This arrangement allowed participants to showcase their skills while maintaining professional commitments during the week.

The inauguration match, held at 7:30 am, featured an eagerly anticipated clash between the Physical Research Laboratory (PRL) and the Space Applications Centre A team. The match ended in an exciting draw with a score of 1-1. Throughout the tournament, PRL team exhibited outstanding performances and remarkable teamwork. They achieved victories against teams such as Space Applications Centre B (2-1), Institute of Plasma Research (5-0), and Oil and Natural Gas Corporation (1-0), showcasing their determination and skills. However, they faced a challenging match against the Indian Institute of Technology Gandhinagar, resulting in a 0-3 loss. PRL made it to the final as the tournament progressed, facing off against the formidable Space Applications Centre B team. The highly anticipated final match was inaugurated by the Director PRL, who praised both teams and extended his best wishes. Despite adverse weather conditions, including overcast skies and rain, the match was fiercely contested, with more than 300 spectators surrounding the ground and cheering for their respective teams. The intense battle of the final match ended in a draw during regulation time, leading to a thrilling penalty shootout. Unfortunately, luck did not favour PRL as we narrowly lost the shootout with a score of 4-3, giving Space Applications Centre B the victory. Director PRL, Prof. Anil Bhardwaj and Dean, PRL, Prof. D. Pallam Raju graced the prize distribution ceremony of the Vikram Sarabhai Space Cup football tournament.

Overall, PRL's participation in the Vikram Sarabhai Space Cup football tournament was marked by exceptional performances, camaraderie, and a display of sportsmanship. The team's journey, from the opening match to the final, showcased their dedication and passion for the sport. Despite falling short in the final, the team will cherish PRL's achievements and experiences gained throughout the tournament and serve as inspiration for future competitions.

To mark the enthusiasm, encouragement and contribution towards PRL sports activities, PRL football team felicitated Prof. Ravi Bhushan with his favourite football team (Barcelona) jersey marked with his name.

### PRL Team

Chandan Kumar (C)

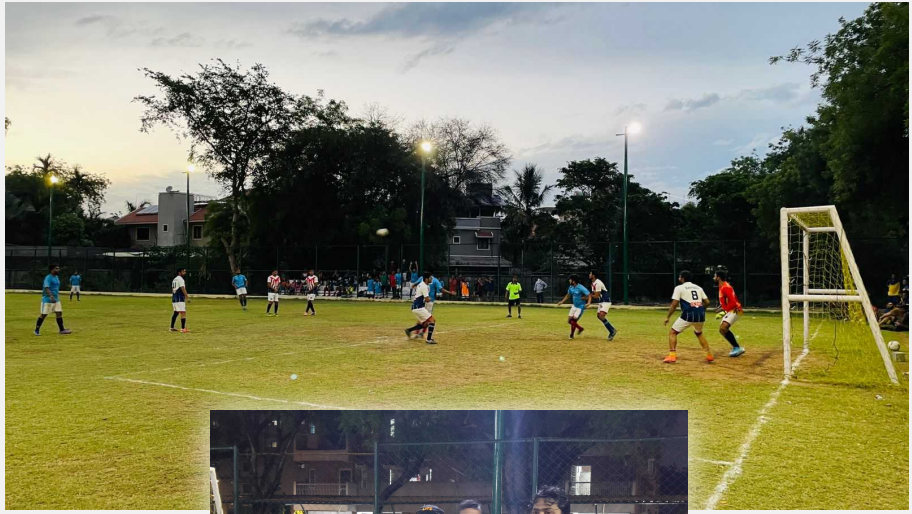
Deepak Kumar Painkra (VC)

P Kalyan Srinivasa Reddy, Saumya Jyoti Sarkar, Aravind K Rohit Meena, Supriya Pan, Arvind Singh Rajpurohit  
Sovan Saha, Rishikesh Sharma, Akash Ganguly, Dibyendu Mishra, Gurucharan Mohanty, R P Singh

D Bharathiganesh (GK), A Shivam (GK)

Goutam Samanta (Team Manager)

**Vikram Sarabhai  
Space Cup  
2023**



**Glimpses from the Event**

## PRL Monthly Publications Digest (April 2023)

### Astronomy & Astrophysics Division [5]

1. Swagat R. Das, Saumya Gupta, Prem Prakash, Manash Samal, and Jessy Jose, 2023, Membership Analysis and 3D Kinematics of the Star-forming Complex around Trumpler 37 Using Gaia-DR3, The Astrophysical Journal, Volume 948, Number 1, Date of Publication: 27/04/2023
2. Abhijit Kayal, Veeresh Singh, Claudio Ricci, N. P. S. Mithun, Santosh Vadawale, Gulab Dewangan, Poshak Gandhi, 2023, Multi-epoch hard X-ray view of Compton-thick AGN Circinus Galaxy, Monthly Notices of the Royal Astronomical Society, stad1216, Date of Publication: 25/04/2023
3. Neeraj Kumari, Arghajit Jana, Sachindra Naik, Prantik Nandi, 2023, Investigation of a small X-ray flaring event in NLS1 galaxy NGC 4051, Monthly Notices of the Royal Astronomical Society, 521, 5440-5452, Date of Publication: 12/04/2023
4. Lakshitha Nama, Biswajit Mondal, S. Narendranath, K. T. Paul, 2023, Coronal Elemental Abundances During A-Class Solar Flares Observed by Chandrayaan-2 XSM, Solar Physics, Date of Publication: 11/04/2023
5. G. K. Jaisawal, G. Vasilopoulos, Sachindra Naik, C. Maitra, C. Malacaria, B. Chhotaray, K. C. Gendreau, S. Guillot, M. Ng, A. Sanna, 2023, On the cyclotron absorption line and evidence of the spectral transition in SMC X-2 during 2022 giant outburst, Monthly Notices of the Royal Astronomical Society, 521, 3951-3961, Date of Publication: 10/04/2023

### Atomic Molecular and Optical Physics Division [1]

1. Devara Anil, Monika Devi, James Blinkhorn, Victoria Smith, Satish Sanghode, Vrushab Mahesh, Zakir Khan, P. Ajithprasad and Naveen Chauhan, 2023, Youngest Toba Tuff deposits in the Gundlakamma River basin, Andhra Pradesh, India and their role in evaluating Late Pleistocene behavioral change in South Asia, Quaternary Research, Date of Publication: 27/04/2023

### Geosciences Division [1]

1. Siddhartha Sarkar, Mohammad Atif Khan, Niharika Sharma, Abdur Rahman, Ravi Bhushan, A. K. Sudheer & Sanjeev Kumar, 2023, Lake desiccation drives carbon and nitrogen biogeochemistry of a sub-tropical hypersaline lake, Hydrobiologia, Date of Publication: 05/04/2023

### Planetary Sciences Division [1]

1. J. P. Pabari, 2023, Likelihood of Martian moons as dust sources in light with Juno observations, Monthly Notices of the Royal Astronomical Society, Date of Publication: 07/04/2023

### Space & Atmospheric Sciences Division [4]

1. Rahul Rathi, Padma Gurram, Subarna Mondal, Virendra Yadav, Sumanta Sarkhel, M.V. Sunil Krishna, Arun K. Upadhyaya, 2023, Unusual simultaneous manifestation of three non-interacting mid-latitude ionospheric plasma structures, Advances in Space Research, Date of Publication: 28/04/2023
2. L. Ram, D. Rout, R. Rathi, S. Mondal, S. Sarkhel, J. Halekas, 2023, A Comparison of the Impacts of CMEs and CIRs on the Martian Dayside and Nightside Ionospheric Species, Journal of Geophysical Research: Planets, Date of Publication: 20/04/2023
3. Sunil Kumar, Tarique A. Siddiqui, Claudia Stoll, Nicholas M. Pedatella, and Duggirala Pallamraju, 2023, Impact of strong and weak stratospheric polar vortices on geomagnetic semidiurnal solar and lunar tides, Earth, Planets and Space, Date of Publication: 10/04/2023
4. de Abreu, A.J., Correia, E., de Jesus, R., Venkatesh, K., Macho, E.P., Roberto, M., Fagundes, P.R. and Gende, M., 2023, Statistical analysis on the ionospheric response over South American mid-and near high-latitudes during 70 intense geomagnetic storms occurred in the period of two decades, Journal of Atmospheric and Solar-Terrestrial Physics, Date of Publication: 01/04/2023

### Theoretical Physics Division [1]

1. Ketan M. Patel, 2023, Minimal spontaneous CP-violating GUT and predictions for leptonic CP phases, Phys. Rev. D 107, 075041, Date of Publication: 28/04/2023

### Udaipur Solar Observatory [2]

1. S. S. Rao, D. Chakrabarty, Nandita Srivastava, 2023, Solar Hysteresis Pattern and Spectral Components in TEC Time Series (GPS and TIE-GCM) of the Quadrilaterally Coupled Geomagnetic Conjugate Low-Latitude Stations, Journal of Geophysical Research, Space Physics, Date of Publication: 26/04/2023
2. Hirdesh Kumar, Brajesh Kumar, S. P. Rajaguru, Shibu K. Mathew, and Ankala Raja Bayanna, 2023, A study of the propagation of magnetoacoustic waves in small-scale magnetic fields using solar photospheric and chromospheric Dopplergrams: HMI/SDO and MAST observations, Journal of Atmospheric and Solar-Terrestrial Physics, Date of Publication: 17/04/2023

## Awards & Honours

**Dr. Jayesh P. Pabari**, Associate Professor, Planetary Sciences Division of PRL has been **invited to join as a member of Industry Advisory Board (IAB)** constituted to strengthen industry linkages, curriculum update and delivery strategies at Department of Electronics and Communication, L.D. College of Engineering, Ahmedabad.

**Dr. Dibyendu Chakrabarty**, Professor, Space and Atmospheric Sciences Division and **Dr. Bhalamurugan Sivaraman**, Associate Professor, Atomic, Molecular & Optical Physics Division, of PRL have been **invited to join as Members of the Research Advisory Committee** of the newly formed **Institute of Astronomy Space and Earth Science (IASSES)**, Salt Lake, Kolkata.

## Grant of External Funds

The proposal jointly by **Prof. Varun Sheel**, Senior Professor and Head, Planetary Sciences Division of PRL, and **Dr. Jayesh P. Pabari**, Professor, Planetary Sciences Division of PRL, on "Role of physical and chemical processes on the climate of Mars & Venus" has been approved for a **Core Research Grant** by the **Science & Engineering Research Board (SERB)**, for a term of 3 years.

The proposal by **Dr. Goutam K Samanta**, Professor, Atomic Molecular and Optical Physics Division of PRL, on "Indigenous development of compact, hands-free, stable, bright entangled photon sources at 810 nm" has been approved for support by the **Department of Science & Technology (DST) - Technology Development Program (TDP) project**, for a term of 3 years.

The proposal by **Dr. Satyajit Seth**, Assistant Professor, Theoretical Physics Division of PRL, on "Precision Calculation via Non-local Slicing" has been approved for support as a **Matrix project** by the **Science & Engineering Research Board (SERB)** for a term of 3 years.

The proposal by **Dr. Kinsuk Acharya**, Associate Professor, Planetary Science Division of PRL, for a "Comprehensive Study of the physical and chemical evolution of volatiles and formation of organics in the comets: from reprocessing of primordial ices in cometary nuclei to the formation of cometary atmosphere during perihelion passage" has been approved for a **Core Research Grant** by the **Science & Engineering Research Board (SERB)**, for a term of 3 years.

The proposal by **Dr. Paramita Dutta**, Assistant Professor, Theoretical Physics Division of PRL, on "Signatures of emergent phases of matter in transport phenomena" has been approved for a **Start-up Research Grant** by the **Science & Engineering Research Board (SERB)**, for a term of 2 years.

### Grant of External Funds (contd.)

The proposal jointly by **Dr. R. D. Deshpande**, Senior Professor, Geosciences Division of PRL, and **Mr. Virendra Padhya**, Scientist/Engineer - SD, Geosciences Division of PRL, on "Defining River health of dryland rivers by developing a process-based hydro-geomorphic model" has been approved for a **Core Research Grant** by the **Science & Engineering Research Board (SERB)**, for a term of 3 years.

The proposal by **Dr. Kuljeet Kaur Marhas**, Professor, Planetary Science Division of PRL, for a "Organics in meteorites: Understanding the parent body processes in the early solar system" has been approved for a **Core Research Grant** by the **Science & Engineering Research Board (SERB)**, for a term of 3 years.

The proposal jointly by **Dr. Ravi Bhushan**, Senior Professor, Geosciences Division of PRL, **Dr. AK Sudheer**, Scientist/Engineer - SF, Geosciences Division of PRL, and **Dr. Navin Juyal**, Scientist/Engineer - SF (Retd.), Atomic Molecular and Optical Physics Division of PRL, on "Tracking the antiquity and climate-human interaction from Iron Age/Late Vedic to Medieval period at Vadnagar using isotope and latest chronological techniques" has been approved for a **Research Project Grant** by the **Directorate of Archaeology & Museums**, for a term of 3 years.

The proposal by **Dr. Rajesh K Kushwaha**, Assistant Professor, Atomic Molecular and Optical Physics Division of PRL, on "Study of ultrafast dynamics in hydrocarbon molecules induced by intense femtosecond laser pulses" has been approved for a **Core Research Grant** by the **Science & Engineering Research Board (SERB)**, for a term of 3 years.

## HEARTY WELCOME TO NEW MEMBER



NAME: DR. PRAVIN PRABHAKAR VAITY

DESIGNATION: RESEARCH ASSOCIATE-III-DST

DATE OF JOINING: 03.04.2023

DIVISION/AREA: ATOMIC, MOLECULAR & OPTICAL PHYSICS  
DIVISION

## VISITORS

1. **Prof. Rajat Moona**, Director, Indian Institute of Technology, Gandhinagar and **Prof. Nithin George**, Dean (Academics), Indian Institute of Technology, Gandhinagar visited PRL on the 17th of April, 2023.
2. **Ms. Sanchari Bhattacharyya** from the University of Calcutta, Kolkata visited Theoretical Physics Division during 15 April to 14 May 2023.
3. **Dr. Navin Gandhi**, Scientist-E and **Dr. Ipsita Roy**, Research Associate from the Indian Institute of Tropical Meteorology, Pune visited Geosciences Division during 26th to 29th April 2023.





## Cyber Security Awareness – Scareware

**Jigar Raval, Head, CNIT, PRL**



### What is Scareware?

It is a type of malware that tricks users into believing their computer is infected with virus or has other issue and then suggest to download or buy malicious software to remove the virus or resolve the issue.



**Warning Signs!!** That May Indicate the Presence of - Scareware



Unexpected Pop-up alerts or notifications.



Unsolicited Scan or System Checks.



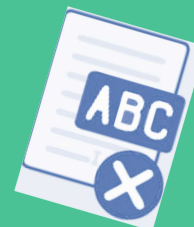
Prompts to Purchase or Download Software.



Scare Tactics and fear-inducing language.



Pressure to take immediate action.



Poor Grammar or Spelling mistake.



Always Get and Use Customer Care Number from the Authorized Company's Website.

**Never Use it by searching on the search engine.**

**Compiled, Designed and Published by**

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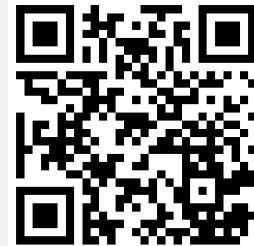
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