



### The Author



Jayesh P Pabari

### About him:

Dr Jayesh Pabari received his Ph. D. from the Indian Institute of Technology Bombay. His research fields are planetary sciences. His research focuses on studying interplanetary dust in the inner solar system, understanding planetary dust, and studying planetary lightning; through modelling and data analysis.

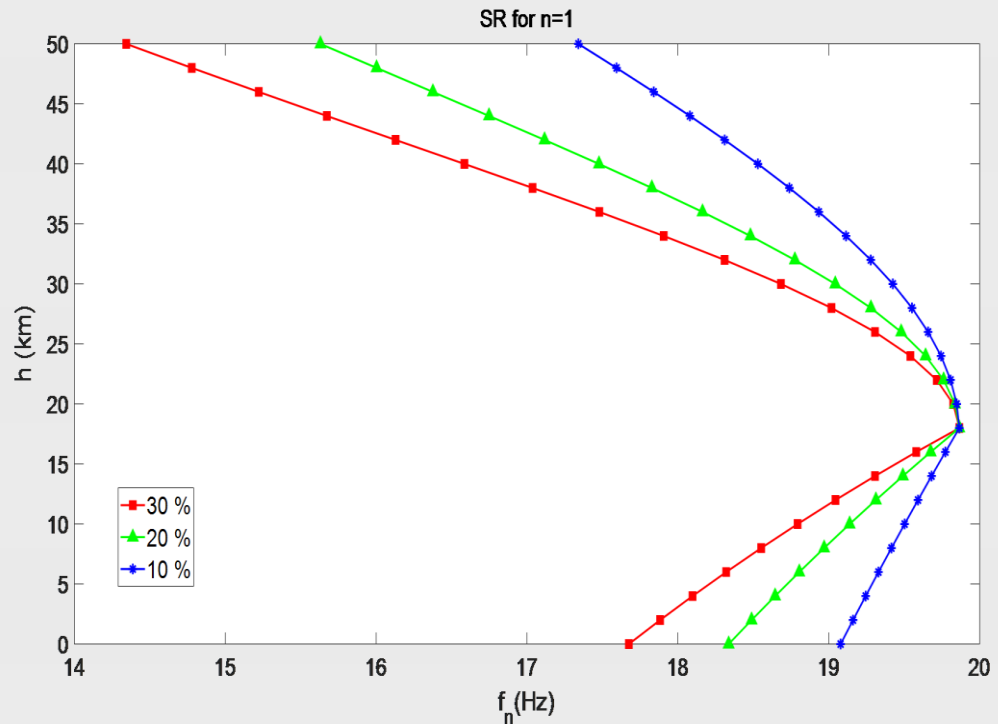


### Dependence of Martian Schumann resonance on the shape of dust devil and its implications

(Jayesh P. Pabari, Trinesh Sana)

Dust Devils (DDs) prevail near the Martian surface during the Southern hemisphere summer. Their whirlpool effect gives rise to smaller particles in the atmosphere, affecting the optical depth and decreasing ion concentration. The presence of dust affects atmospheric conductivity and permittivity, which in turn affect electromagnetic wave propagation. An understanding of the underlying physics of electrical discharges due to dust is critical for future missions. Low atmospheric pressure and arid, windy environment suggest that dust is more susceptible to triboelectric charging. This article presents a study of Schumann Resonance (SR) on Mars, whose presence indicates the possibility of lightning. We have extended our previous work for variable dust mixing. A random dust mixing is chosen, and finally, an inverted cone-shaped DD is considered for effective permittivity. It is found that SR modes essentially depend on the shape of DDs, which consequently determines the effective permittivity of the medium. Also, SR does not depend much on conductivity. At present, the InSight magnetometer is searching for the presence of SR on Mars. Our results could be useful for future missions to carry out *in-situ* measurements of SR, the most promising detection related to electrical activity on Mars.

[10.18520/cs/v121/i6/769-774](https://doi.org/10.18520/cs/v121/i6/769-774)



**Figure caption:** Fundamental, observable SR during Martian year 28 for conical (shape dependent) dust distribution.

The Author



Trinesh Sana

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Mr Trinesh Sana is Junior Research fellow in Planetary Sciences division.



Moon: Static equilibrium dust levitation may not exist

(S. K. Mishra and Trinesh Sana)

The composite system of the charged lunar surface, electron, and plasma cloud, and the charged dust create the dusty plasma over the Moon. This plasma environment is maintained by the interaction between the lunar surface and the solar photon radiation and solar wind/ magnetotail plasma. Photons in the extreme ultraviolet range primarily generate photoelectrons over the sunlit locations. In addition to that, solar wind electrons and ions are accreted to the lunar surface. The cumulative effect of these three creates a positively charged lunar surface on the dayside — emitted photoelectrons near the surface form a dusty photoelectron sheath over the lunar surface. The dust particles within the photoelectron sheath get electrically charged due to various dust charging currents – these charging currents undergo natural random fluctuations. Due to natural randomization of the dust charging currents, the anisotropy in sheath photoelectron population and electric field/potential, and half Fermi–Dirac velocity distribution of the emitted photoelectrons, the charge on the floating dust particles is found to be distributed over a wide range (~100 e). Alteration of static equilibrium of the floating dust particles due to this natural charge fluctuation gives rise to the altitudinal fluctuation (~10 %) about its mean position within the sheath. This effect of dust charge and subsequent altitudinal fluctuations have been found pronounced at larger latitudes (near the terminator region) and higher lunar altitudes. The concept and results suggest that the natural fluctuation of the dust charge could be a reason that the strict dust levitation under static force equilibrium is less likely to exhibit over the sunlit lunar surfaces. The predictions based on natural dust charge fluctuations may be of practical significance in preparing test experiments for future lunar exploration campaigns.

<https://doi.org/10.1093/mnras/stab2862>

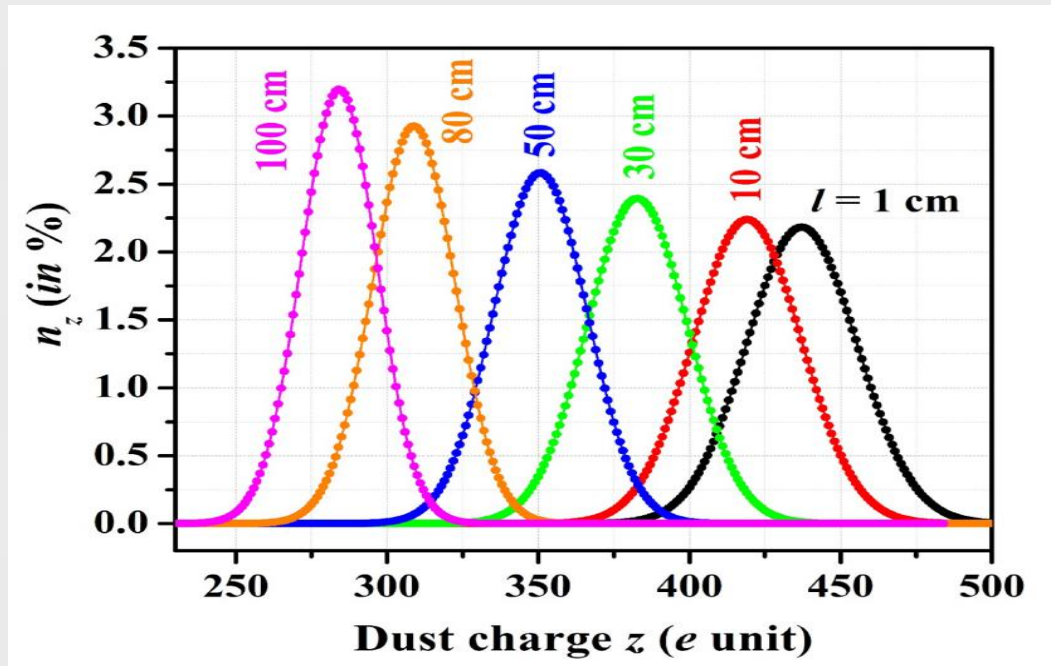


Figure caption: Charge distribution ( $n_z$  vs  $z$ ) over the dust particles floating at different lunar altitudes within photoelectron sheath under static equilibrium

The Author



Biswajit Mondal

About him:

Mr Biswajit Mondal is Senior Research fellow in Astronomy & Astrophysics Sciences division.



Evolution of Elemental Abundances during B-Class Solar Flares: Soft X-Ray Spectral Measurements with Chandrayaan-2 XSM

(Biswajit Mondal, Aavek Sarkar, Santosh V. Vadawale, N. P. S. Mithun, P. Janardhan, Giulio Del Zanna, Helen E. Mason, Urmila Mitra-Kraev, S. Narendranath)

Determining elemental abundances at different layers of the Sun is crucial for understanding the mass and energy outflow from the star. It has been observed that abundances of certain elements whose First Ionization Potential (FIP) is lower than 10eV are 2-4 times more abundant in the atmosphere of the magnetically active regions of the Sun than that of the solar surface. The phenomenon is popularly known as the FIP bias of the Sun. This has been studied extensively in the past decades. However, the time evolution study of elemental abundances during the transient events, e.g., the solar flare, was limited due to instrumental limitation. A recent instrument, Solar X-ray Spectrometer (XSM) onboard the Chandrayaan-2 spacecraft, can provide a high-resolution spectrum of the Sun at every second. Its high spectral resolution (180 eV at 5.9 keV) and sensitivity have been useful for time-resolved spectroscopy. Using such a technique, one can study the abundance evolution during impulsive events like solar flares. During the period from 2019 September to 2020 May, covering the minimum of Solar Cycle 24, it observed nine B-class flares ranging from B1.3 to B4.5. Using time-resolved spectroscopic analysis during these flares, we examined the evolution of temperature, emission measure, and absolute elemental abundances of four elements—Mg, Al, Si, and S. These are the first measurements of absolute abundances during such small flares, and this study offers a unique insight into the evolution of absolute abundances as the flares evolve. Our results (Figure 1) demonstrate that the abundances of these four elements decrease toward their photospheric values during the peak phase of the flares. During the decay phase, the abundances are observed to return to their preflare coronal values quickly. The depletion of elemental abundances during the flares is consistent with the standard flare model, suggesting the injection of fresh material into coronal loops as a result of chromospheric evaporation. To explain the quick recovery of the coronal "FIP bias", we propose two scenarios as explained in Figure 2; the first one is based on the evaporative plasma velocity during the flaring process, whereas the second one relies on the flare driven Alfvén waves, generated at the flaring site.

<https://doi.org/10.3847/1538-4357/ac14c1>

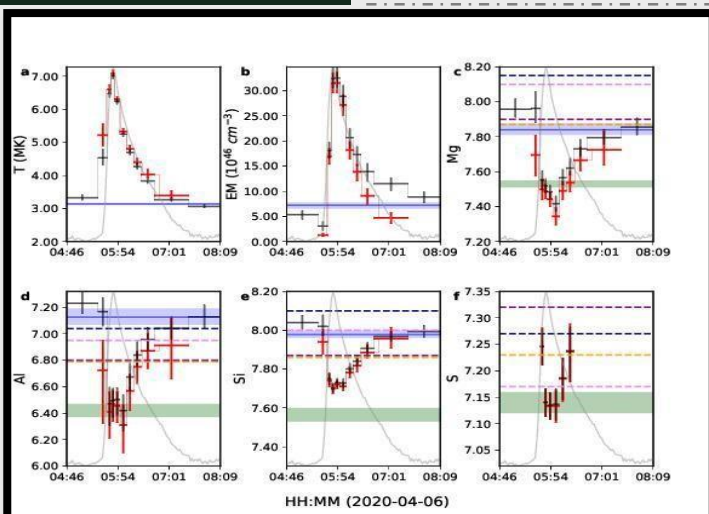


Figure caption: The six panels show the results of the time-resolved X-ray spectroscopy. Panels (a-b) show the variation of the temperature and emission measure, respectively, while panels (c-f) show the variation of elemental abundances.

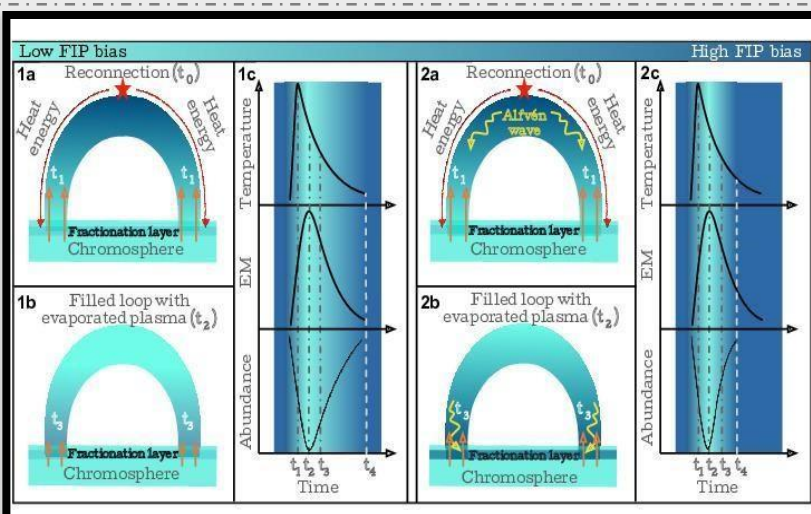


Figure caption: Schematic representation of flaring loop dynamics with lighter color representing the low-FIP bias and darker color indicating high-FIP bias. Panels (1a-1c) show scenario 1: Relies on the evaporative plasma velocity, and panels (2a-2c) show scenario 2: Bashed on flare driven Alfvén wave, generated at the flaring site.

## Monthly Publications of PRL

1. P. Kushwaha, M. Pal, N. Kalita, Neeraj Kumari, Sachindra Naik, A. C. Gupta, E. M. de Gouveia Dal Pino, and M. Gu, 2021, *Blazar OJ 287 after First VHE Activity: Tracking the Reemergence of the HBL-like Component in 2020*, The Astrophysical Journal, 921, 18, *Date of Publication: 28/10/2021*
2. Biswajit Mondal, Aveek Sarkar, Santosh V. Vadawale, N. P. S. Mithun, P. Janardhan, Giulio Del Zanna, Helen E. Mason, Urmila Mitra-Kraev, and S. Narendranath, 2021, *Evolution of Elemental Abundances during B-Class Solar Flares: Soft X-Ray Spectral Measurements with Chandrayaan-2 XSM*, The Astrophysical Journal, 920 4, *Date of Publication: 06/10/2021*
3. Jangirh, R., Ahlawat, S., Arya, R., Mondal, A., Yadav, L., Kotnala, G., Yadav, P., Choudhary, N., Rani, M., Banoo, R., Rai, A., Singh, U., Rastogi, N., Patel, A., Shivani, S., Gadi. R., Saxena, P., Vijayan, N., Sharma, C., Sharma, S.K., Mandal, T., 2021, *Gridded distribution of total suspended particulates (TSP) and their chemical characterisation over Delhi during winter. Environmental Science and Pollution Research* , Environmental Science and Pollution Research, *Date of Publication: 22/10/2021*
4. Harsh Raj, Ravi Bhushan, Sanjeev Kumar, Upasana Banerji, Chinmay Shah, Sangeeta Verma, 2021, *Monsoon signature in corals from the northern Indian Ocean*, Journal of Marine Systems, *Date of Publication: 14/10/2021*
5. Abdur Rahman, Ajayeta Rathi, Romi Nambiar, Praveen Mishra, Ambili Anoop, Ravi Bhushan, Sanjeev Kumar, 2021, *Signatures of natural to anthropogenic transition in lake sediments from the Central Himalaya using stable isotopes*, Applied Geochemistry, *Date of Publication: 06/10/2021*
6. Thamban, N., Lalchandani, V., Kumar, V., Mishra, S., Bhattu, D., Slowik, J., Prevot, A. S. H., Satish, R., Rastogi, N., and Tripathi, S. N., 2021, *evolution of size and composition of fine particulate matter in the Delhi megacity during later winter*, Atmospheric Environment 267, 118752, *Date of Publication: 04/10/2021*
7. Varun Sheel, Shefali Uttam, S. K. Mishra, 2021, *Numerical simulation of dust lifting within a steady state dust devil*, Journal of Geophysical Research: Planets, *Date of Publication: 21/10/2021*
8. M. B. Dhanya, Smitha V. Thampi, Tirtha Pratim Das R. Satheesh Thampi, Neha Naik, J. K. Abhishek, P. Sreelatha, P. Pradeepkumar, G. Padma Padmanabhan, B. Sundar, Dinakar Prasad Vajja, Amarnath Nandi, Vipin K. Yadav, M. Mohammed Nazeer, P. T. Lali, Rosmy John, A. V. Aliyas, Vijay Kumar Sen, M. Ram Prabhu, A. Ajay Krishna, Tarun K. Pant, and Anil Bhardwaj, 2021, *Argon-40 in Lunar Exosphere: Observations From CHACE-2 on Chandrayaan-2 Orbiter*, Geophysical Research Letters, *Date of Publication: 20/10/2021*
9. S. K. Mishra & Trinesh Sana, 2021, *Distribution of charge on floating dust particles over sunlit locations on Moon*, Monthly Notices of the Royal Astronomical Society (MNRAS), *Date of Publication: 06/10/2021*
10. Ghosh, S., Tiwari, K., Niyahara, M., Rohrbach, A., Vollmer, C., Stagno, V., Ohtani, E. and Ray, D., 2021, *Natural Fe-bearing aluminous bridgmanite in the Katol L6 chondrite*, PNAS, *Date of Publication: 05/10/2021*

## Visitors @ PRL

- Mr Arvind Kumar Mishra, Ex PRL PhD scholar, is visiting PRL from 19.10.2021 to 03.12.2021. He would be working with Prof. Srubabati Goswami, THEPH division.
- Ms Neha, a research Scholar from HNBG University, Srinagar, is visiting PRL from 15.10.2021 to 31.12.2021 to work on geochemistry and geochronological studies. She would be working with Prof. A.D. Shukla, Geosciences division.

## PRL features in ISRO story of the week

A recent work on the discovery of inflated hot-Jupiter (exoplanet) by PRL scientists using PRL's 1.2 m telescope at Mt Abu and PARAS instrument by Ms Akanksha Khandelwal, Priyanka Chaturvedi, Prof. Abhijit Chakraborty, Mr Rishikesh Sharma, Eike W. Guenther, Carina M. Persson, Malcolm Fridlund, Artie P. Hatzes, Mr Neelam J. S. S. V. Prasad, Massimiliano Esposito, Sireesha Chamathi, Mr Ashirbad Nayak, Mr Dishendra, Steve B. Howell has been highlighted as an "ISRO Story of the Week" on 15 November 2021.

The ISRO story of the week can be accessed from:

<https://www.isro.gov.in/update/15-nov-2021/discovery-of-inflated-hot-jupiter-around-sub-giant-star-prl-scientists>

We heartily congratulate the team from PRL on this well-deserved recognition and wish them continued success in their scientific endeavours.

## Awards & Honours

- Dr Anil Bhardwaj, Director, PRL, has been selected for Prof. M. G. K. Menon Lecture Award 2021 by the National Academy of Sciences, India (NASI).
- Dr Arvind Singh, Associate Professor, Geosciences Division of PRL, has been selected for the Swarnajayanti Fellowship for the year 2021 by the DST.
- Dr Jayesh Pabari, Scientist/Engineer-SF, Planetary Sciences Division, PRL, has been appointed as a member of the Doctoral Research Committee for several disciplines at Gujarat Technological University, Ahmedabad, for a period of 3 years.

We congratulate all for the recognitions and wish them continued success in their scientific endeavours.

**Events & Activities**

**Vigilance Awareness Week @ PRL**

Vigilance Awareness Week (VAW) – 2021 was observed in PRL from 26 October 2021 to 01 November 2021. The theme of the VAW-2021 was “स्वतंत्र भारत @ 75; सत्यनिष्ठा से आत्मनिर्भरता” / "Independent India: Self Reliance with Integrity". All the staff Members of PRL took Integrity Pledge at their respective workplaces on 26.10.2021.

Apart from Integrity Pledge, all staff members were encouraged to take Integrity E-pledge in the CVC portal (<https://pledge.cvc.nic.in>). A total of 86 PRL Staff have taken E-pledge for which online Certificates are downloadable from the CVC portal. Integrity E-Pledge as an organisation has also been taken for PRL.

An online quiz on the occasion of VAW-2021 was also conducted on 29.10.2021, in which 36 PRLites had participated. The winners of this quiz will be announced and awarded during the Republic Day celebration on 26.01.2022.

An online lecture was also conducted on the subject “स्वतंत्र भारत @ 75; सत्यनिष्ठा से आत्मनिर्भरता” / “Independent India: Self Reliance with Integrity”. The invited speaker was Shri Pawan Srivastava, IPS and Director, Central Academy of Police Training, Bhopal. In his one and half hour lecture, Shri Pawan elaborated on the evolution of the Indian economy from the pre-independence era to date, how corruption is impacting our economy and remedial measures to combat corruption.

A few glimpses of the week in form of photographs and certificates are here:



PRL ka Amrut Vyakhyaan @ PRL

- **PKAV-10** Dr. Madhulika Guhathakurta, Senior Advisor for New Initiatives, Heliophysics, NASA GSFC/HQ Program Scientist delivered a colloquium entitled "*A Song for the SOL*" on 06 October 2021
- **PKAV-11** Dr. Ralph Lorenz, Planetary scientist and Engineer at the Johns Hopkins Applied Physics Lab, Maryland, USA delivered a colloquium entitled "*The Mystery of VENUS Lightning*" on 13 October 2021
- **PKAV-12** Dr. M. Rajeevan, Former Secretary from Ministry of Earth Sciences, Govt. of India delivered a colloquium entitled "*Earth System Science for Socio-Economic Benefits*" on 20 October 2021
- **PKAV-13** Prof. Jonathan Tennyson FRS, Massey Professor of Physics and Head of Department, Department of Physics and Astronomy, from University College London (UCL), Chief Scientist, Quantemol Ltd, UCL delivered a colloquium entitled "*What are exoplanets made of? Molecular line lists to aid the characterisation of exoplanets.*" On 27 October 2021

Inauguration of PRL E2 accommodation in Vikramnagar



Director, PRL inaugurated the most awaited and long pending ambitious project of E2 Block in PRL, Vikramnagar colony during Navaratri celebration on October 12, 2021. This could be achieved only with the keen interest of Director, PRL with the support of CMG, SAC. All programme connected with inauguration were arranged with in a short notice period. Director, PRL want the staff members eligible for occupying the new E2 quarters are to be moved on the auspicious occasion of Navratri/Diwali and wish them a healthy, wealthy and prosperous stay in the new E2 Block of PRL Housing colony in Vikramnagar. Director PRL handed over the keys of the quarters to the respective staff members. On this occasion, also arrangement has been made for planting trees by the allottee of the new E2 Block. Accordingly, all members allotted with the accommodation were planted a tree in the colony and tagged to their name and will be maintained by them with the support of horticulture staff.

PRL Garba 2021

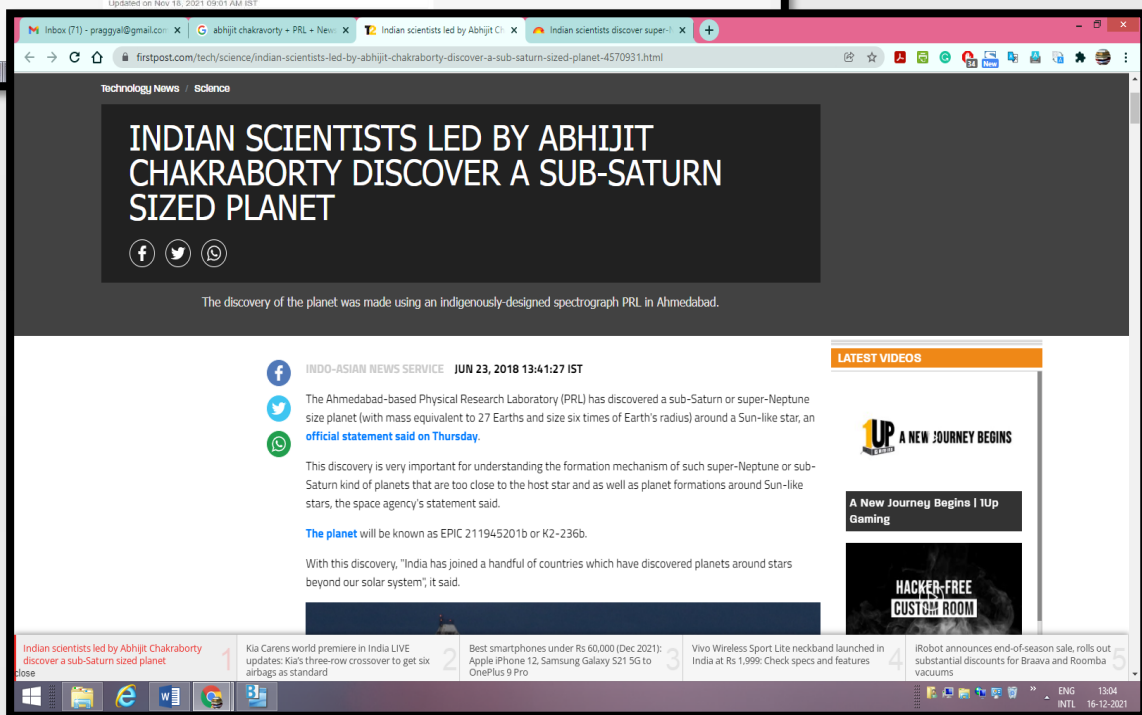
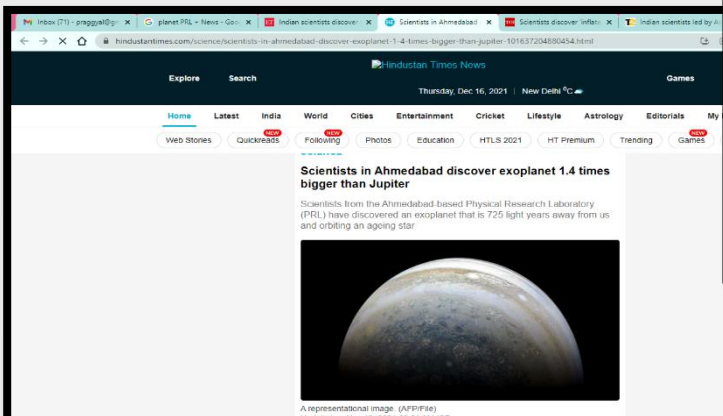
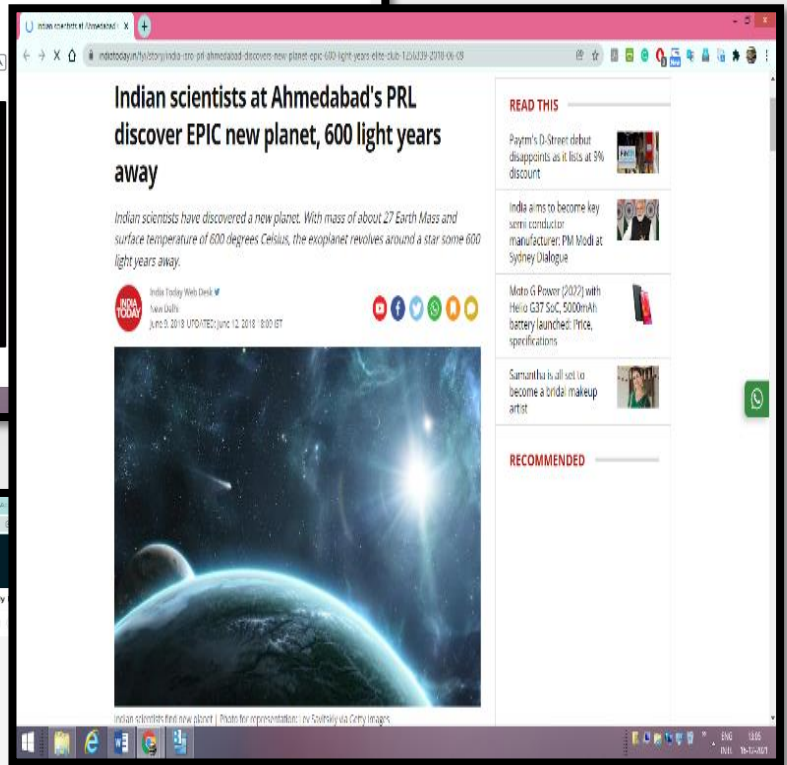
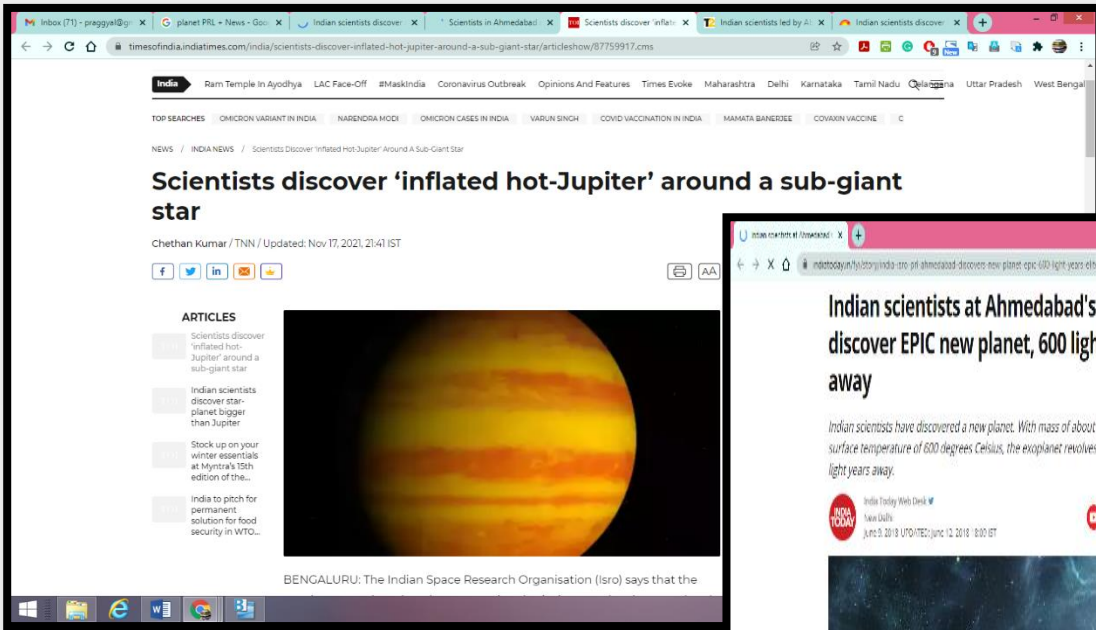


As a part of Navaratri Celebration and on the occasion of inauguration of new E2 block accommodation in PRL, Vikramnagar colony, SWC, PRL in coordination with Vikramnagar Residents Association (VRA) arranged PRL Garba 2021 in Vikramnagar colony on 12 October 2021, Maximum staff members with their family, Research Scholar, PDF, Office Trainees etc. are participated in the event. The main attraction was presence of Director with spouse in the Garba ground throughout the programme in its real spirit, which motivates the others to their active participation in the event. The event really regenerate the energy lost due to the pandemic during year 2020 & 21. All members strictly followed the guidelines issued by Government, Local body and PRL on COVID-19.





PRL in News



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