



### The Author



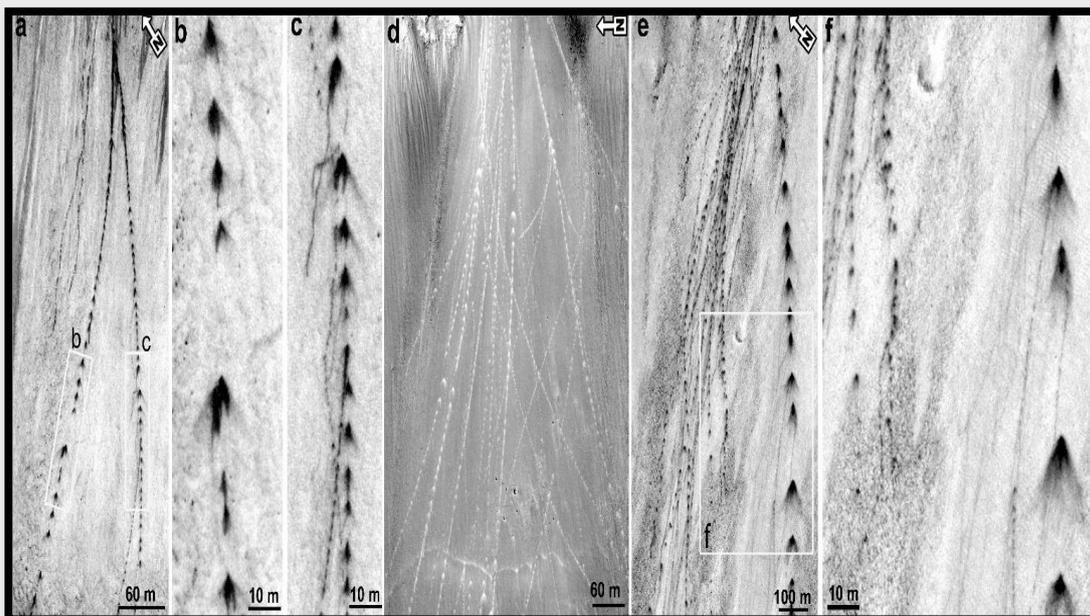
Vijayan S

### Impact of the September 2019 minor sudden stratospheric warming on the low latitude middle atmospheric planetary wave dynamics

(S Vijayan, Harish, KB Kimi, S Tuhi, K Vigneshwaran, RK Sinha, SJ Conway, B Sivaraman, Anil Bhardwaj)

Boulder falls are an archives of recent surface activity on Mars, however, determining how recently they fell remains elusive. High-resolution images of Mars have revealed numerous boulder falls on the surface. Here, we systematically surveyed images from 2006 to 2020 to find recent boulder falls which have ejecta along each tracks. The images of the same place taken at different times, revealed that the new tracks are characterized by a herringbone-like ejecta pattern at each boulder bounce that we call boulder fall ejecta (BFE). We searched all the images and found BFE present in large numbers suggesting recent falls are common and widespread. First systematic survey of BFE revealed ~4,500 tracks whose total integrated track length is ~900 km. Our BFE longevity analysis reveals that these tracks likely formed in the last few decades. BFE fade in as little as ~2 to 4 Mars years, whereas, others can persist >6 Mars years suggesting differential weathering, whereas on Earth BFE are rarely preserved. We found that the Cerberus Fossae region adjacent to NASA's InSight lander landing site hosts nearly 30% of BFE, suggesting it is a currently active region on Mars. Thus, BFE can be used to recognize very recent surface processes on planetary surfaces

Reference: <https://doi.org/10.1029/2021GL096808>



**Figure:** Formation of boulder track with ejecta. a-c, Boulder fall ejecta with a diverse spread of ejecta along the track. d, multiple boulder tracks with light-toned ejecta. e, the ejecta spread along the track varies. f, spacing between the bounces and ejecta spatial spread varies and small sub-tracks from some boulder bounces. All images have an applied stretch to best highlight the BFE.

Reference:  
[https://doi.org/10.1007/JHEP08\(2021\)080](https://doi.org/10.1007/JHEP08(2021)080)

**Chemical-hydrodynamical Modelling of First Interstellar Comet 2I/Borisov***(Sana Ahmed and Kinsuk Acharyya)*

Comets are among the least altered objects in our solar system, and they can preserve the chemical and physical signatures of the protoplanetary disk that formed the solar system. Recent observation of the interstellar comet 2I/Borisov provides a great opportunity to study the physical conditions that prevailed in a distant unknown planetary system. Comet 2I/Borisov shows a higher CO/H<sub>2</sub>O ratio compared to the solar system comets observed at a heliocentric distance < 2.5 AU. We studied the coma of comet 2I/Borisov using a multifluid chemical-hydrodynamical model built in-house at PRL. The model includes a host of chemical reactions, with the neutrals, ions, and electrons treated as three separate fluids. Radiative losses and energy exchange between these fluids via elastic and inelastic scattering are also considered. We find a high abundance of CO<sup>+</sup> and HCO<sup>+</sup> ions in the coma of 2I/Borisov, and show how these ions affect the creation/destruction rates of other ions such as H<sub>2</sub>O<sup>+</sup>, H<sub>3</sub>O<sup>+</sup>, N-bearing ions, and large organic ions. We find higher abundance of large organic ions and neutrals such as CH<sub>3</sub>OH<sub>2</sub><sup>+</sup>, CH<sub>3</sub>OCH<sub>4</sub><sup>+</sup>, and CH<sub>3</sub>OCH<sub>3</sub>, as compared to H<sub>2</sub>O-rich solar system comets. We conclude that the CO-rich coma of comet 2I/Borisov, combined with a low production rate, affects the coma temperature profile and flux of major ionic species significantly.

Reference: <https://doi.org/10.3847/1538-4357/ac2a42>

**The Author**

Sana Ahmed



**Figure:** Image of comet 2I/Borisov by the *Hubble Space Telescope*

**Optical and near-infrared spectroscopy of Nova V2891 Cygni: evidence for shock-induced dust formation**

(Vipin Kumar, Mudit K Srivastava, Dipankar P K Banerjee, C E Woodward, Ulisse Munari, Aneurin Evans, Vishal Joshi, Sergio Dallaporta, and Kim L Page)

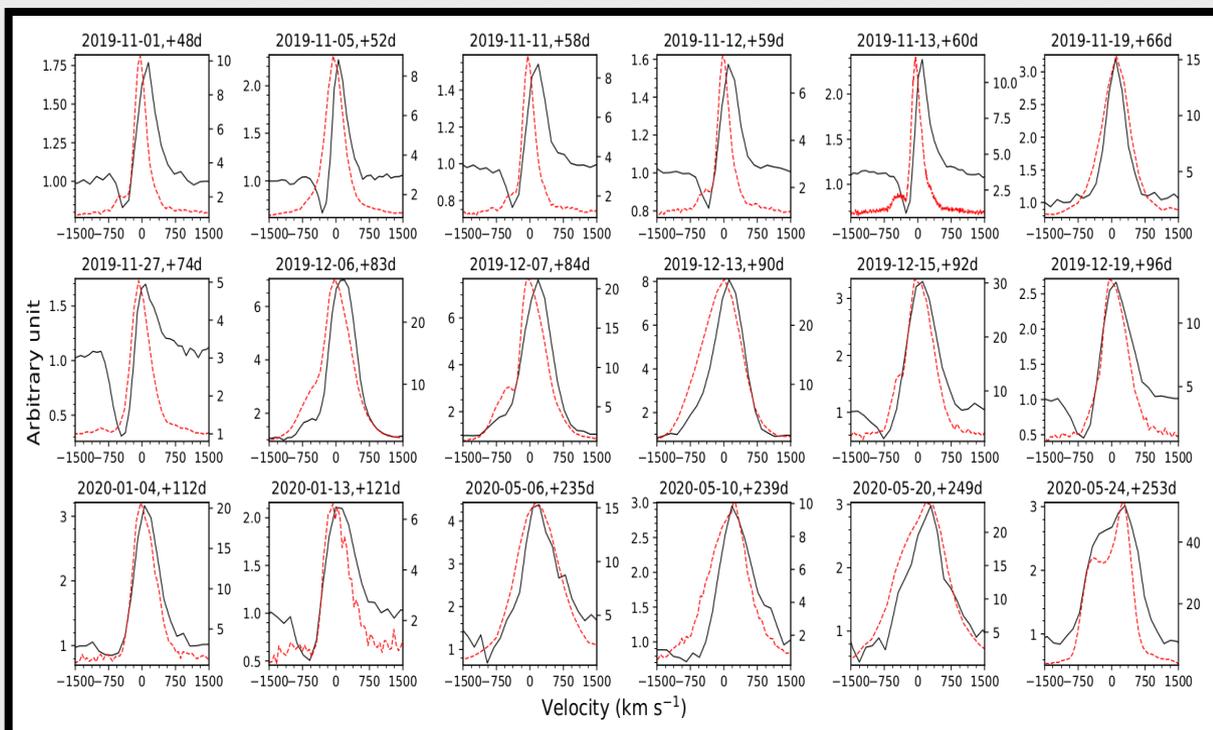
**The Author**



Vipin Kumar

Nova outbursts are caused by thermonuclear runaway events on the surface of a degenerate white dwarf, which has accreted gas from the Roche-lobe overflow of a secondary star in a close binary system. Nova V2891 Cyg was discovered in September 2019 and later classified as a slow nova of Fe II class. Nova V2891 Cyg had been followed in optical wavelengths with indigenously developed MFOOSC-P instrument on PRL 1.2m Mt. Abu telescope and other worldwide facilities for its multi-wavelength evolution for nearly 15 months since its discovery. The photometric monitoring of the object revealed it to be a very slow nova (one of the slowest novae recorded in recent times) with a rather unusual, nearly flat, light curve. The evidence that the current outburst of V2891 Cyg has undergone several distinct episodes of mass ejection is seen through time-varying P Cygni profiles of the O I 7773 Å line (see the attached figure). Such episodes of mass ejection provided the most suitable environment for the shocks. It is proposed that these shock-induced conditions gave rise to the high-excitation coronal lines emissions during the nova evolution. A short period of dust formation also occurred, which coincided with the appearance of these coronal emission lines. The simultaneous occurrence of the dust and coronal lines (with varying velocity shifts) supports the possibility that dust formation was also shock-induced. Such a route for dust formation has not previously been seen in a nova, and these phenomena are rare in the evolution of novae. Thus, the data set of this observational campaign and our associated analysis would be of interest to the community to explore the physics of the nova phenomenon.

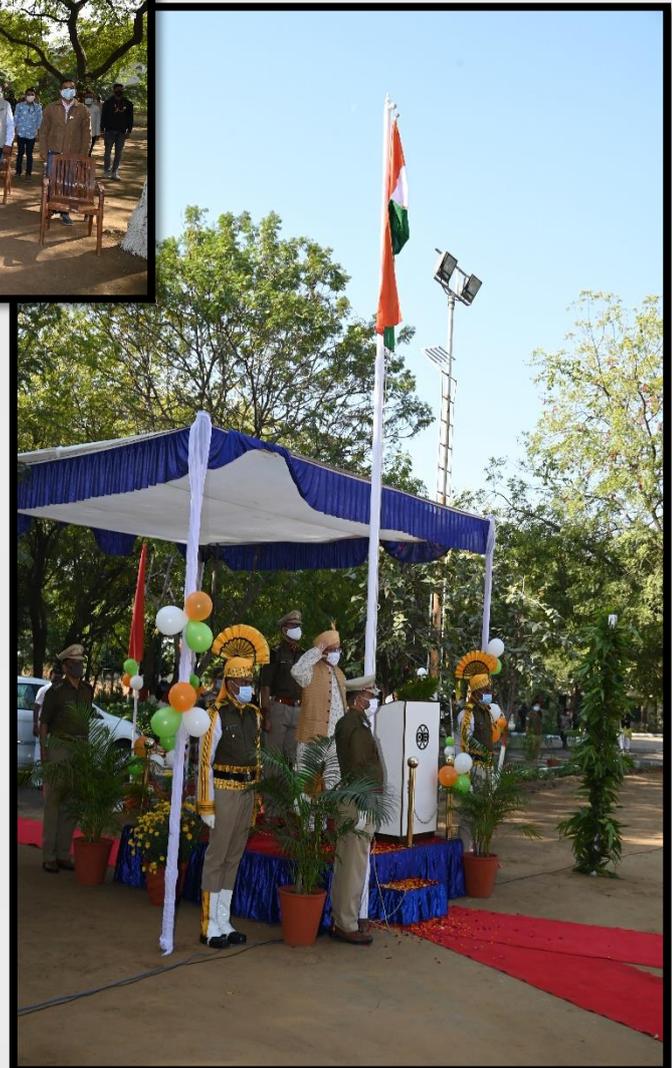
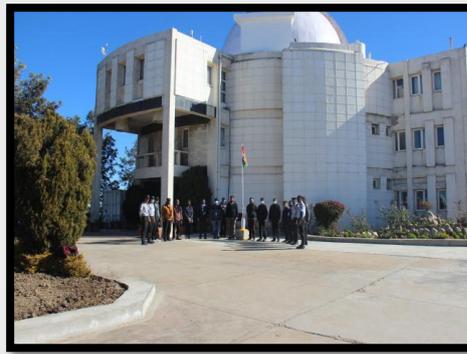
Reference: *Monthly Notices of the Royal Astronomical Society, Volume 510, Issue 3, March 2022, Pages 4265–4283*



**Figure:** The line profile variation seen in the O I 7773Å (solid black) and H $\alpha$  (dashed red) lines during 2019 Nov - 2020 May for the Nova V2891 Cyg. The relative flux for O I 7773Å and H $\alpha$  are given on the left and right axes for each of the sub-plots respectively. The appearance and disappearance of P Cygni features is evident. These profile variations are the indicators of multiples episodes of periodic mass ejections in the nova outbursts.

## Celebration of Republic Day at PRL

**73<sup>rd</sup> Republic Day** was celebrated in all its solemnity and grandeur at all campuses of PRL on 26th January 2022. Dr. Anil Bhardwaj, Director, PRL hoisted the national flag clock with a General Salute by the CISF personnel. He inspected the Guard of Honour presented by CISF personnel. After that, he briefed the audience about the activities, achievements, honours etc. acquired by PRL during the year. He also presented awards to CISF Personnel for their exceptional services and distributed the prizes to the winners of various competitions held at PRL. At last, he extended his warm wishes to all staff members and their family on the auspicious occasion. This was followed by a tree plantation by PRL Staff members.



## Celebration of Swachhta Pakhwada at PRL

As mandated by the Department of Space/GoI, Swachhta Pakhwada was celebrated during February 01-18, 2022 (extended by a week) at all the campuses including Ahmedabad, Mount Abu and Udaipur and at all the Residential Colonies of PRL. The theme for Pakhwada was “Health and Sanitisation.” PRL urged all members to give special focus on weeding out old records and eradicating plastic uses.

The Pakhwada activity started with Mass Pledge duly following Covid -19 protocols. Swachhta Pakhwada Committee (SwPC) organized various activities and events in which PRL members have participated with great enthusiasm. Weeding out of Record and Cleanliness Drives were organized on various schedules at all four campuses focusing mainly to pick up the plastic materials in the campus. To attract public participation, awareness rallies and cleanliness drives were conducted outside the PRL office campus at Ahmedabad.

Awareness lectures were arranged by PRL Medical Officers for contractual staff to make them aware of routine hygiene and sanitation and to give up tobacco use. A Special Webinar PRL@75 was arranged, and Dr. Deepak C. Jagani on “Hygiene and Sanitation.” Fogging and fumigation as routine was conducted in all the campuses as well as Residential Colonies. Staff welfare Associations have also taken the lead and organized a cleanliness drive at respective Residential Colonies involving the participation of residents and family members. CISF conducted a cleanliness drive at PRL Thaltej Campus, CISF Canteen area.

To make Pakhwada Activity more participative for the staff members, an online quiz, essay competition (extended to family members), and skit competitions were announced. The Closing Ceremony was arranged at PRL Thaltej Campus, at an open venue. The Closing ceremony started with National Song sung by Cultural activity team member. A brief of the Swachhta Pakhwada was presented by the Sh. A.B. Shah, Chairman, SwPC. Dr. Anil Bhardwaj, the Director, PRL, has addressed the gathering emphasizing views that Swachhta is not limited to Pakhwada activity, it is indeed a way of life. The Director, PRL, gave away prizes of the winners of Online Quiz, Skit, and Essay Competitions.

Dr. Pallam Raju, Dean, PRL, Dr. R. D. Deshpandey, Chair PPEG, have also addressed the gathering and expressed their views. Dr. Som Sharma and Sh. Sanjay Wairagade, the Co-chairs, were present to oversee all arrangements.

A movie of various activities undertaken during Swachhta Pakhwada was presented by Sh. Pradeep Kumar Sharma, Convener SwPC. Screening of Skit, as prepared by Administration Division, was well applauded by the gathering and was message conveying. The Chair, SwPC, has also announced the long-term activities to be accomplished throughout the year by the SwPC.



## PRL Ka Amrut Vyakhyan

- ✚ **PKAV-23** Prof. Sun Kwok The University of Hong Kong, Hong Kong and University of British Columbia, Vancouver, BC Canada delivered a vyakhyan entitled “Organic Matter in the Universe” on 5 January 2022.
  
- ✚ **PKAV-24** Prof. Daniel N. Baker Director, Laboratory for Atmospheric and Space Physics, University of Colorado, Boulder, Colorado, delivered a vyakhyan entitled “Societal and Economic Impacts of Space Weather” on 12 January 2022.
  
- ✚ **PKAV-25** Prof. Girish S. Agarwal, FRS Institute for Quantum Science and Engineering, Departments of Biological and Agricultural Engineering, and Physics and Astronomy, Texas A&M University, USA, delivered a vyakhyan entitled “Squeezed light from abstraction to real-life applications: sensing and imaging well beyond standard quantum limit” on 19 January 2022.

**PRL Monthly Publications Digest**
Astronomy & Astrophysics Division [3]

1. Dewangan, Lokesh Kumar, Zinchenko, I. I., Zemlyanukha, P. M., Liu, S.-Y., Su, Y.-N., Kurtz, S. E., Ojha, D. K., Pazukhin, A. G., Mayya, Y. D., 2022, [The disk-outflow system around the rare young O-type protostar W42-MME](#), The Astrophysical Journal, Volume 925, Issue 1, id.41, 25 pp., Date of Publication: 24/01/2022
2. S. Karmakar, Sachindra Naik, J. C. Pandey, I. S. Savanov, 2022, [AstroSat observations of long-duration X-ray superflares on active M-dwarf binary EQ Peg](#), Monthly Notices of the Royal Astronomical Society, 509, 3247-3257, Date of Publication: 03/01/2022
3. A. Joshi, W. Wang, J. C. Pandey, K. P. Singh, Sachindra Naik, A. Raj, G. C. Anupama, N. Rawat, 2022, [X-ray confirmation of the intermediate polar IGR J16547-1916](#), Astronomy & Astrophysics, 657, A12, Date of Publication: 03/01/2022

Atomic, Molecular and Optical Physics [3]

1. B. K. Sahoo, B. P. Das, and H. Spiesberger, 2022, [Reply to “Comment on ‘New physics constraints from atomic parity violation in  \$^{133}\text{Cs}\$ ’”](#), Phys. Rev. D 105, 018302 (2022), Date of Publication: 31/01/2022
2. R Ramachandran, S Pavithraa, J K Meka, K K Rahul, J I Lo, S L Chou, B M Cheng, B N Rajasekhar, Anil Bhardwaj, N J Mason, B Sivaraman, 2022, [Vacuum ultraviolet photoabsorption spectra of icy isoprene and its oligomers](#), Spectrochimica Acta Part A - Molecular and Biomolecular Spectroscopy, Date of Publication: 18/01/2022
3. Varun Sharma, S. Chaitanya Kumar, G. K. Samanta, and M. Ebrahim-Zadeh, 2022, [Tunable, high-power, high-order optical vortex beam generation in the mid-infrared](#), Optics Express Vol. 30, Issue 2, pp. 1195-1204 (2022), Date of Publication: 11/01/2022

Geosciences Division [2]

1. Harsh Raj; Ravi Bhushan; Upasana S. Banerji; M. Muruganantham; Chinmay Shah; Romi Nambiar; Ankur J. Dabhi, 2022, [Air-sea CO<sub>2</sub> exchange rate in the northern Indian Ocean based on coral radiocarbon records](#), Applied Geochemistry, Date of Publication: 13/01/2022
2. P. R. Lekshmy, M. Midhun, R. Ramesh, 2022, [Role of moisture transport from Western Pacific region on water vapor isotopes over the Bay of Bengal](#), Atmospheric Research, 265, 105895, Date of Publication: 01/01/2022

Space and Atmospheric Sciences Division [4]

1. K. Gopalan, B. P. Shukla, Som Sharma, P. Kumar, A. Shyam, A. Gaur, and S. Sunda, 2022, [An Observational Study of GPS-Derived Integrated Water Vapor over India](#), Atmosphere, Date of Publication: 31/01/2022
2. M. Jain, P. Saxena, Som Sharma, and S. Sonwani, 2022, [Investigation of Forest Fire Activity Changes Over the Central India Domain Using Satellite Observations During 2001–2020](#), GeoHealth (AGU), Date of Publication: 31/01/2022
3. Sunil Kumar, Duggirala Pallamraju, Pradip Suryawanshi, Tatiparti Vijayalakshmi, Gopi K. Seemala, 2022, [On the latitudinal variation in OI 630.0 nm dayglow emissions in response to the equatorial electrodynamic processes and neutral winds](#), Advances in Space Research, Date of Publication: 15/01/2022

- Ashish Soni, Stefano Decesari, Harish Gadhavi, Marco Paglione, Douglas Orsini, Vijay Shridhar, Ujjwal Kumar and Francesca Volpi , 2022, [Chemical composition and radiative forcing of atmospheric aerosols over the high-altitude Western Himalayas of India](#), Environmental Science and Pollution Research, Date of Publication: 12/01/2022

#### Theoretical Physics [2]

- Hiranmaya Mishra, 2022, [Coloursuperconductivity in magnetised quark matter: an NJL model approach](#), The European Physics Journal ST, Date of Publication: 29/01/2022
- Aman Abhishek, Arpan Das, Deepak Kumar and Hiranmaya Mishra, 2022, [Thermoelectric transport coefficients of quark matter](#), The European Journal of Physics C82, 71, (2022), Date of Publication: 24/01/2022

#### Planetary Sciences Division [2]

- Arpit Patel, Himanshu Mazumdar, Bhumi Patel, 2022, [A new approach for pulse amplitude measurement using Lagrange’s interpolation for radiation or particle detectors](#), Advances in Space Research, Date of Publication: 24/01/2022
- Tanu Singh, Neeraj Srivastava, Megha Bhatt, Anil Bhardwaj, 2022, [Geology of the Crüger-Sirsalis Basin: Evidence for prolonged volcanism in the southwestern near side of the Moon](#), Icarus, Date of Publication: 03/01/2022

## Obituary



**Late Miss Ranna A. Patel**  
**Computer Scientist-SD**  
**30.05.1949 to 24.01.2022**  
**Date of retirement**  
**31.05.2009**



**Late Shri K.K. Upadhyay**  
**Cook ‘B’**  
**01.06.1951 to 16.01.2022**  
**Date of retiremen**  
**31.05.2011**

## Follow PRL on Social Media



<https://twitter.com/PRLAhmedabad>



<https://www.facebook.com/PhysicalResearchLaboratory>



[https://www.youtube.com/c/PRLAhmedabad\\_webinars](https://www.youtube.com/c/PRLAhmedabad_webinars)

## PRL Contact



<https://www.prl.res.in/prl-eng/home>



website-Hindi



website-English



PRL-Contact

### Physical Research Laboratory

(A unit of Dept. of Space, Govt. of India)  
Navrangpura, Ahmedabad - 380009  
Phone: (079) 26314000  
Fax: (079) 26314900  
E-Mail: [director@prl.res.in](mailto:director@prl.res.in)

### भौतिक अनुसंधान प्रयोगशाला

(भारत सरकार, अंतरिक्ष विभाग की यूनिट)  
नवरंगपुरा, अहमदाबाद - 380009  
दूरभाष: (079) 26314000  
फैक्स: (079) 26314900  
ई - मेल: [director@prl.res.in](mailto:director@prl.res.in)

## Compiled, Designed and Published by



**The Newsletter Team**  
**Physical Research Laboratory**



Previous issues available at: <https://www.prl.res.in/prl-eng/newsletter>



For any suggestions or query, please contact us at: [newsletter@prl.res.in](mailto:newsletter@prl.res.in)