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Evidence of Regionally Distributed Tectono-Volcanism in a Floor Fractured Crater of North-Central Arabia Terra, Mars

(A. Rani, A. Basu Sarbadhikari, R. K. Sinha, S. Karunatillake, G. Komatsu, A. Bates)

Arabia Terra's is one of the oldest regions of Mars consists of highly cratered and heavily eroded plains, which is situated at a critical geologic division between the Martian highlands and lowlands. Previously, plain-style caldera complexes that resembles to terrestrial supervolcanic calderas have been reported in Northern Arabia Terra. However, the geomorphic extent of volcanism in Arabia Terra is not constrained. In this context, we discuss previously unrecognized evidence of intrusive igneous process at the center of a floor-fractured crater (FFC) in North-Central Arabia Terra.

We consider whether the observed geomorphic features are related to impact cratering or regional intrusive activity during the late Noachian - early Hesperian time. Our study reveals the existence of volcanic cones and dikes within the central floor of the crater. We also observe a preferred orientation of the igneous features, which shows a parallel alignment to regional linear tectonic features. We suggest that the igneous intrusions within the FFC were controlled preferably along the pre-existing weak planes (i.e., faults) in response to the regional tectonism, while the FFC-forming impact event primarily triggered the magmatism. These findings shed new light on the regionally distributed magmatic systems within Arabia Terra during the late Noachian and early Hesperian

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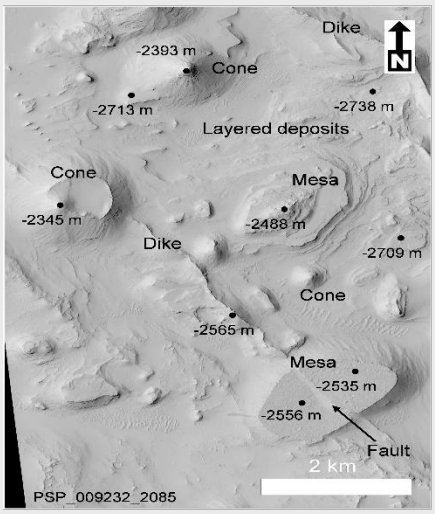


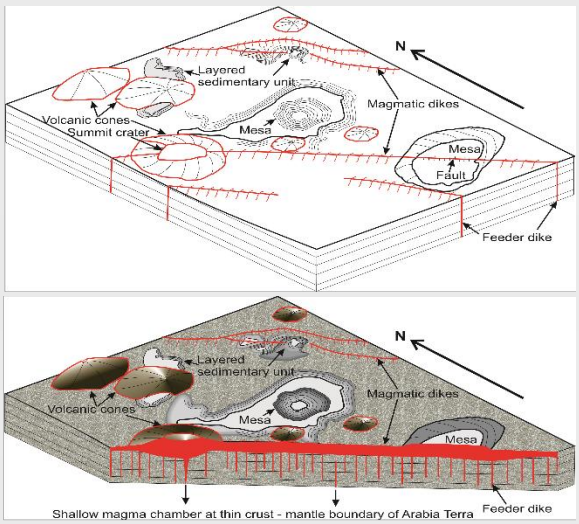


Figure caption: *Left panel: Part of the central portion of the study crater with major landforms. Right panel: A schematic diagram and model for the origin of the volcanic landforms in our study area (not to scale). (HiRISE image credit: NASA/JPL Caltech/University of Arizona)*

Monthly Publications of PRL

1. Phillips, H.E., A. Tandon, R. Furue, R. Hood, C. Ummenhofer, J. Benthuysen, V. Menezes, S. Hu, B. Webber, A. Franks, D. Cherian, E. Shroyer, M. Feng, H. Wijeskera, A. Chatterjee, L. Yu, J. Hermes, R. Murtugudde, T. Tozuka, D. Su, Arvind Singh, L. Centurioni, S. Prakash and J. Wiggert , 2021 ,*Progress in understanding of Indian Ocean circulation, variability, air–sea exchange, and impacts on biogeochemistry,* Ocean Science, 17, 1677–1751, *Date of Publication: 26/11/2021*

2. Vinayachandran, P.N.M., Y. Masumoto, M. Roberts, J. Hugget, I. Halo, A. Chatterjee, P. Amol, G.V.M. Gupta, Arvind Singh, A. Mukherjee, S. Prakash, L. Beckley, E. Raes, and R. Hood, 2021, *Reviews and syntheses: Physical and biogeochemical processes associated with upwelling in the Indian Ocean,* Biogeosciences, 18, 5967–6029, *Date of Publication: 23/11/2021*

3. Talukdar, S., Tripathi S.N., Lalchandani, V., Rupakheti, M., Bhowmik, H.S., Shukla, A.K., Murari, V., Sahu, R., Jain, V., Tripathi, N., Dave, J., Rastogi, N., Sahu, L, 2021, *Air Pollution in New Delhi during Late Winter: An Overview of a Group of Campaign Studies Focusing on Composition and Sources,* Atmosphere, *Date of Publication: 01/11/2021*

4. Nariaki V. Nitta, Tamitha Mulligan, Emilia K. J. Kilpua, Benjamin J. Lynch, Marilena Mierla, Jennifer O'Kane, Paolo Pagano, Erika Palmerio, Jens Pomoell, Ian R. Richardson, Luciano Rodriguez, Alexis P. Rouillard, Suvadip Sinha, Nandita Srivastava, Dana-Camelia Talpeanu, Stephanie L. Yardley & Andrei N. Zhukov , 2021, *Understanding the Origins of Problem Geomagnetic Storms Associated with "Stealth" Coronal Mass Ejections,* Space Science Reviews, 217, 82 (2021), *Date of Publication: 03/11/2021*

5. A.J. de Abreu, E. Correia, C.M. Denardini, R. de Jesus, K. Venkatesh, M. Roberto, J.R. Abalde, P.R. Fagundes, M.J.A. Bolzan, M. Gende, 2021, *Ionospheric GPS-TEC responses from equatorial region to the EIA crest in the South American sector under intense space weather conditions,* Journal of Atmospheric and Solar-Terrestrial Physics, *Date of Publication: 20/11/2021*

6. N. Ojha, I. Girach, K. Sharma, A. Sharma, N. Singh, S. S. Gunthe, 2021, *Exploring the potential of machine learning for simulations of urban ozone variability, Scientific Reports,* *Date of Publication: 18/11/2021*

7. Saptarshi Dey, Bodo Bookhagen, Rasmus C. Thiede, Hella Wittmann, Naveen Chauhan, Vikrant Jain, Manfred R. Strecker, 2021, *Impact of Late Pleistocene climate variability on paleo-erosion rates in the western Himalaya,* Earth and Planetary Science Letters, *Date of Publication: 26/11/2021*

8. D. K. Nandy and B. K. Sahoo, 2021, *Relativistic-coupled-cluster-theory analysis of properties of Co-like ions,* Phys. Rev. A 104, 052812 (2021), *Date of Publication: 19/11/2021*

9. Dabhi, M., Chavan, A., Thakkar, A., Chauhan, G., Bhagora, R., Chauhan, N., Shukla, A.D., Bhandari, S., 2021, *Climatic history from early Weichselian (MIS 5D-C) valley-fill deposits and associated factors for basin sedimentation, mainland Kachchh, western India*., Quaternary International, *Date of Publication: 06/11/2021*

10. Himanshu Swami, Kinjalk Lochan, Ketan M. Patel, 2021, *Aspects of gravitational decoherence in neutrino lensing,* Phys. Rev. D 104, 095007 (2021), *Date of Publication: 10/11/2021*

SCOP 2021 @ PRL

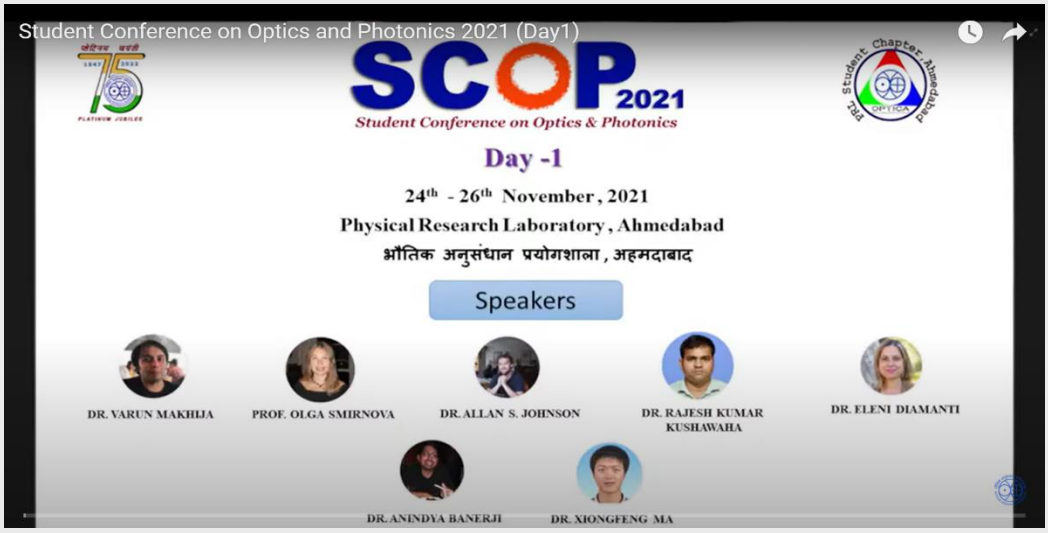
The sixth edition of the Student Conference on Optics and Photonics (SCOP) was organized from 24th to 26th November 2021 by the OPTICA (previously OSA) Student Chapter of Physical Research Laboratory (PRL). The PRL-OPTICA student chapter has been organizing this conference since 2016. SCOP-2021 was organized as a three-day conference with six technical sessions in a webinar considering the prevailing pandemic. In the last five SCOPs, we have hosted 20 international speakers, 60 Indian speakers, and 130 Indian student speakers. However, taking the opportunity of the webinar mode, we managed thirty-three invited speakers, including nineteen faculty and fourteen students. Among the nineteen invited dignitaries, we had twelve speakers from nine countries spanning three continents (Asia, Europe, and America) and seven from India.

On the other hand, we accommodated 14 student talks, four international students, and twelve Indian students. The conference was open for all attendees, and we were happy to have 129 registrations for SCOP 2021, making it a mega International student conference.

The conference highlighted the recent research and advancements in the numerous fields of optics, including Ultrafast Spectroscopy and Molecular Dynamics, Quantum optics and Quantum Information, Nonlinear Optics and Structured beams, Quantum Metrology, and Sensing. Furthermore, SCOP-2021 has included researchers from the interdisciplinary fields actively using light.

As always, we started the conference with an inaugural session. Director PRL, Prof. Anil Bhardwaj, offered generous support and encouragement to organize the SCOP, gave a motivational speech, and officially opened the SCOP 2021. We started the technical session of SCOP 2021 with an invited talk by Dr. Varun Makhija (University of Maryland, Washington) on *Ultrafast Spectroscopy and Molecular Dynamics*. Subsequently, Dr. Anindya Banerji (PDF, National University of Singapore) talked on Entanglement distribution through telecom fibres and Dr. Allan Johnson (The Hebrew University of Jerusalem) talked on Ultrafast soft X-ray science. Dr. Eleni Diamanti (Pierre and Marie Curie University, France), Prof. Olga Smirnova (Max Born Institute for Nonlinear Optics and Short Pulse Spectroscopy, Germany), and Prof. Xiongfeng Ma (Tsinghua University, China) were the speakers for the second session on *Quantum optics and Quantum Information*. We had Prof. Greg Gbur (University of North Carolina at Charlotte), Dr. Wagner Tavares Buono (PDF, University of the Witwatersrand, Johannesburg), Prof. Basudev N. Roy (IIT-Madras), and Prof. Miguel A. Alonso (University of Rochester, New York) as the speakers for the third technical session on *Nonlinear Optics and Structured Beam*.

Similarly, Prof. Daniele Faccio (University of Glasgow, UK), Prof. Robert Fickler (Tampere University, Finland), and Prof. Joyee Ghosh (IIT-Delhi) delivered their talks in the fourth technical session on *Quantum Metrology and Quantum Sensing*. The fifth technical session on interdisciplinary fields, named *Let there be Light,* covered the speakers Prof. Sudipta Maiti (TIFR, Mumbai), Prof. Mudit K Srivastava (PRL, Ahmedabad), and Dr. Alfredo Sanchez (PDF, ICFO - The Institute of Photonic Sciences . The sixth or the last technical session of SCOP covered *Nonlinear Optics and Structured Beam* with Prof. Prem Bisht (IIT-Madras) and Prof. Ravi Hedge (IIT-Gandhinagar) as invited speakers.
A vote of thanks concluded the three-day-long conference.



Kids Day @ PRL

To celebrate the birth anniversary of Sir C V Raman and the 75th Platinum Year of the foundation of Physical Research Laboratory, a function named "KIDS DAY@PRL" was organized at PRL. Beneficiary Children of PRL Staff members along with their family members were invited to PRL on Thursday, the 11th November 2021.

Duly following COVID protocols, the event started at K R Ramanathan Auditorium with the warm welcome of all the kids along with staff members and spouses. To highlight the importance of the day, an informative speech was delivered by the Director PRL in the form of a short presentation and kids showed their excitement for the event.

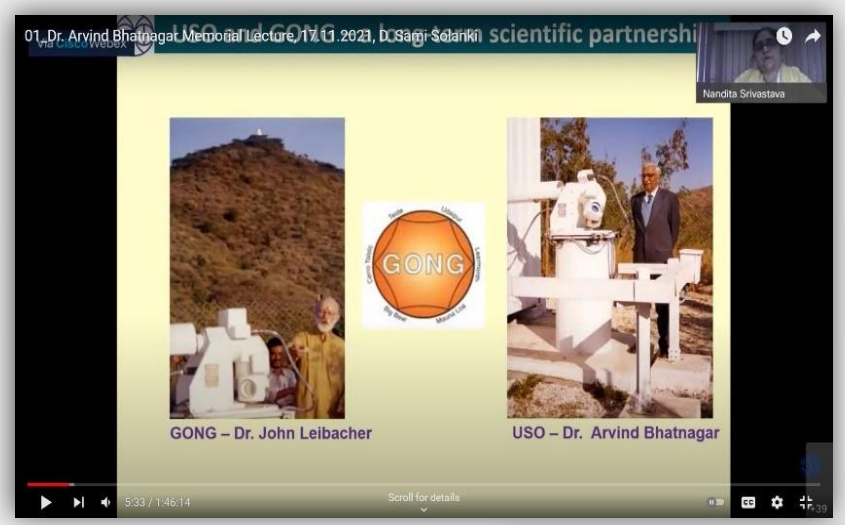
Since the KIDS DAY@PRL was focused on children, their enjoyment and promoting the spirit of science was at the center. To execute the full-day event in a smooth and organized manner, kids were divided into different age groups. Teams comprising of faculties and staff members of PRL were formed for each group, based on their learning and observation skills. Accordingly, the PRL teams prepared their activities for kids as per their group and kept them engaged the whole day so they can learn something new. Further, a visit to all PRL labs, workshop, Computer Centre and Library was organized in a phased manner to make kids understand the work done in a scientific organization. A career counseling session was organized by the Director, PRL, and other senior faculty members of PRL for kids of the age group of 18 and above. This was a very lively and informative session that proved to be a key to multiple avenues of career development.

In the concluding session, a mesmerizing Magic-Show was presented by one of the Faculty members, where some scientific experiments were shown and explained in the form of magic. Kids were overwhelmed and enjoyed a lot and their enthusiasm was worth watching even in the evening of such a busy day. In the concluding session, kids of all ages were presented with a Do-It-Yourself (DIY) kit by the Director, PRL.

Events & Activities

Dr. Arvind Bhatnagar Memorial Lecture

Udaipur Solar Observatory (USO) was founded in 1975 by the visionary scientist Dr. Arvind Bhatnagar. This observatory, located on a small island in the lake Fatehsagar, has proved the significance of a lake-site for recording solar images. Since becoming a part of the Physical Research Laboratory (PRL) in 1981, USO has emerged as a leading centre for Solar Physics in the country and the world. The last 40 years have witnessed a phenomenal transformation of the facility. In 1995, USO-PRL became a part of the prestigious Global Oscillation Network Group (GONG), a flagship synoptic program at the National Solar Observatory, USA, to study the internal structure of the Sun. In 2015, the 50-cm Multi-Application Solar Telescope (MAST) was installed at the island site of USO-PRL, making it a state-of-the-art facility to study the Sun with very high spatial and temporal resolution. USO-PRL is organizing the "Dr. Arvind Bhatnagar Memorial Lecture" dedicated to the memory of Late Dr. Arvind Bhatnagar, the founder of USO, and his contributions to solar physics research in India. The Lecture is aimed at commemorating the rich history and growth of USO-PRL. This lecture will be organised every year in the month of November, close to the birth-date of Dr. Bhatnagar, i.e., 19th November. The first Dr. Arvind Bhatnagar Memorial Lecture has been initiated in 2021, with the Platinum Jubilee Year of PRL, and features as a special lecture of the "PRL Ka Amrut Vyakhyaan" series, which is being organised to celebrate 75 years of foundation of PRL and also of India's independence. Prof. Sami K. Solanki, Director, Max-Planck-Institute for Solar System Research (MPS) in Germany, delivered the inaugural Dr. Arvind Bhatnagar Memorial Lecture on Wednesday, 17 November 2021. The title of his online lecture was "The Sun's Magnetic Field and Global Climate Change". Several colleagues from PRL as well as other National Research Centres attended the lecture.



Seasonal Flu Vaccination Camp

Seasonal Flu is a viral infection, causes fever or feeling chills, cough, sore throat, runny or stuffy nose, muscle or body aches, headaches, fatigue(tiredness), some people may have vomiting and diarrhoea. Influenza viruses are constantly changing and new strains appearing regularly. So it is advisable to get vaccinated against flu infection every year.

Benefits of Seasonal Flu Vaccination:

(i) Protects against seasonal flu including H1N1.
(ii) Reduces the risk of flu-associated hospitalization.
(iii) Important preventive tool for people with comorbid conditions like lung diseases, High BP, Diabetes, Cardiac Conditions.

Moreover, the on-going studies on effect of flu vaccination during COVID-19 pandemic suggests:

(i) It lowers the risk of death in COVID patient.
(ii) It mitigates the risk of complication in hospitalized COVID patient.

Seasonal Influenza Vaccination Camp was arranged at Navrangpura Dispensary during 21st & 22nd December 2021. 279 CHSS beneficiaries were registered for vaccination. Registered beneficiaries were divided into group of 25 people and each group was allotted staggered time slot. In a wake of COVID-19, they were strictly advised to visit vaccination camp only within the given time slot to avoid mass gathering. Beneficiaries were given prior intimation to strictly comply with COVID-19 guidelines while coming for vaccination. The total number of beneficiary covered under Flu Vaccination Camp is 290.

MetMeSS 2021

As a part of PRL's Platinum Jubilee celebration, the Planetary Laboratory Analysis Section in PSDN of PRL organised a two-day online meeting " **Meteoroids, Meteors and Meteorites - Messengers from Space** " during 29-30th November 2021.

The symposium aimed at bringing prominent scientists to present their latest results that advance our understanding of the solar system formation and evolution. The following scientific themes were covered in the symposium

- Session-1: Stardusts & Starbits! (Pre-Solar Grains, Interplanetary Dust Particles, Early Solar System Solids)
- Session-2: Chondrites & Micrometeorites: Events and Processes
- Session-3: Journey to Differentiated Worlds (Earth-Mars-Moon-Asteroids)Surface processing of planetary bodies)
- Session-4: Atmosphere and Meteors
- Session-5: Impact Shocking and Shattering!!!
- Session-6: Planetary Analogue: Similar Environment of Dissimilar World!

Keynote speaker Professor Trevor Ireland discussed about the structure of the solar system. Talks on OSIRIS-REX mission, by Prof. Dante Lauretta and Hayabusa-2 mission, by Prof. Shogo Tachibana were organized. Other invited talks on meteorite curation (by Prof. Sara Russel) and meteors (Dr K Rajeev) were also presented. About 127 delegates from national and international institutes attended the conference.

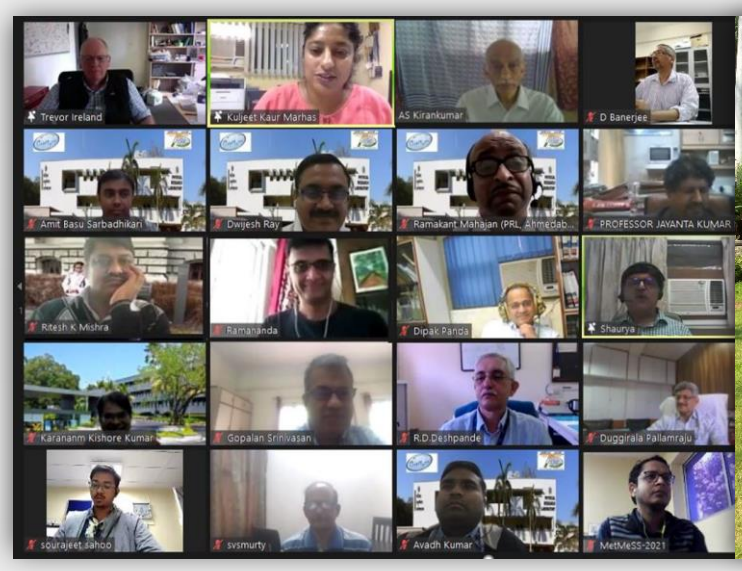
There were about 50 talks distributed in 6 sessions covering search areas from pre solar studies to meteor radars. The session chairs were from various centres.

Participation for this conference was from eminent universities/institutes from all over the world like PRL, St. Xavier's college, Tokyo institute of technology, PUNJAB university, IIT-Kharagpur, NIO-Goa, GSI, University of Bern Switzerland,, Florida State university, IISc, SSRI, IIT-Roorkee, SPPU-Pune, SPL, NIT-Calicut, University of Kerala, University of Allahabad, IIST, University of Lucknow, Presidency University, BMSIS Seattle, Washington

Shri A. S. Kiran Kumar (Council Chair, PRL) and Dr. Anil Bhardwaj (Director, PRL) graced the inaugural session Senior Scientists and PRL Alumni Dr Narendra Bhandari and Dr. SVS Murty, graced the conference with their experiences and stories about the evolution of meteorite studies in PRL. Panel Discussion chaired by Professor Anil Bhardwaj (director , PRL) was held at the end of the conference.

The conference was convened by Professor Kuljeet Kaur Marhas .

Dr. D. Pallamraju (Dean, PRL), the SOC and LOC members, Dr. Bhushit Vaishnav (Head, Academic Services), IT team, opted members, electrical team and other members contributed immensely towards making this conference a successful one.



PRL ka Amrut Vyakhyaan

- **PKAV-14** Prof. V. Adimurthy, ISRO Honorary Distinguished Professor, Vikram Sarabhai Space Centre, Thiruvananthapuram, delivered a colloquium entitled ***"Opportunities and Challenges beyond Mangalyaan in Interplanetary Missions and Planetary Protection Measures"*** on 03 November 2021
- **PKAV-15** Shri Sanjay Lalbhai, Chairman and Managing Director, Arvind Ltd., Ahmedabad, delivered the colloquium entitled ***"Business Journey and Learnings on the Way"*** on 10 November 2021
- **PKAV-16** Prof. Sami K. Solanki from Max Planck Institute for Solar System Research, MPS, Göttingen, Germany, delivered the 1st Dr Arvind Bhatnagar Memorial Lecture entitled ***"The Sun's Magnetic Field and Global Climate Change"*** on 17 November 2021
- **PKAV-17** Prof. Andrew Bowie from Institute for Marine and Antarctic Studies (IMAS), University of Tasmania, Hobart, Tasmania delivered a colloquium entitled "***GEOTRACES and Southern Ocean iron biogeochemistry - where have we come?"*** on 24 November 2021

बधाई संदेश

नगर राजभाषा कार्यान्वयन समिति, अहमदाबाद के तत्वावधान में अंतरिक्ष उपयोग केंद्र (सैक), अहमदाबाद द्वारा दिनांक 30.11.2021 को आयोजित "अपनी हिंदी परखें" प्रतियोगिता में श्रीमती हर्षा परमार, वरिष्ठ परियोजना सहायक को "ख भाषा क्षेत्र" के अंतर्गत द्वितीय पुरस्कार प्राप्त हुआ।

Visitors @ PRL

- Mr Anil Devara, a PhD student from MSU, Baroda, is visiting PRL from 01.11.2021 to 20.11.2021 for his thesis work. He would be working with Dr Naveen Chauhan, AMOPH division.
- Ms. Zeel Pravinkumar Patel, M.Sc.(Physics) student from the Department of Physics, HNGU, Patan, is visiting PRL from 01.11.2021 to 28.02.2022. She would be working with Dr J.P. Pabari, Planetary Sciences division.

New Joinee @ PRL

Name : MR. SAURABH SUMAN

Designation : JUNIOR PERSONAL ASSISTANT

Date of Joining : 30.11.2021

Division/Area : DEAN'S OFFICE (ADMDN)

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