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The 4th State

Newsletter of the Institute For Plasma Research, Gandhinagar, Gujarat (India)



हिंदी कार्यशाला

केन्द्रीय लोक निर्माण विभाग (CPWD), गांधीनगर द्वारा दिनांक 26 दिसंबर 2023 को विशेष महानिदेशक कार्यालय, मुंबई एवं कार्यालय मुख्य अभियंता गांधीनगर के तत्वावधान में एक ऑनलाइन हिंदी कार्यशाला का आयोजन किया गया। इस कार्यशाला में महाराष्ट्र में स्थित केन्द्रीय लोक निर्माण विभाग के पांच कार्यालयों के कर्मिकों ने भाग लिया। कार्यशाला में प्रशिक्षण देने हेतु प्लाज्मा अनुसंधान संस्थान की हिंदी अधिकारी डॉ. संध्या दवे को "हिंदी में सरलता से कामकाज कैसे करें" विषय पर प्रशिक्षण देने हेतु आमंत्रित किया गया। डॉ. संध्या दवे ने कार्यालय में रोजमर्रा के कामकाज में हिंदी भाषा को सम्मिलित करने के छोटे-छोटे प्रयासों पर प्रकाश डाला। उन्होंने हिंदी में कार्य करने की आवश्यकता एवं कंप्यूटर पर उपलब्ध विभिन्न सॉफ्टवेयर/टूल्स के उपयोग - अनुवाद टूल्स, वाईस टाइपिंग टूल्स, कंप्यूटर पर हिंदी में प्रकाशन सामग्री तैयार करना, हिंदी भाषा प्रशिक्षण ऐप आदि की जानकारी प्रदान की। साथ ही राजभाषा विभाग की वेबसाइट पर उपलब्ध अनुवाद टूल्स कंठस्थ 2.0 पर चर्चा की एवं विभिन्न उद्घरणों के माध्यम से मशीनी अनुवाद करते समय होने वाली समस्याओं एवं उसके समाधानों पर भी प्रकाश डाला।



कार्यशाला की तस्वीरें

हिंदी व्याख्यान

संस्थान की राजभाषा कार्यान्वयन समिति ने श्रीमती छाया चावडा, वैज्ञानिक अधिकारी-एच को अपने अनुभवों पर हिंदी में एक व्याख्यान देने का अनुरोध किया गया। समिति के अनुरोध पर श्रीमती छाया चावडा ने दिनांक 21 दिसंबर 2023 को "अनमोल अनुभवों से भरी आईपीआर में मेरी यात्रा" विषय पर व्याख्यान दिया। श्रीमती छाया चावडा ने आईपीआर में लगभग 38 वर्षों की सेवा प्रदान की है। दिसंबर 2023 में उनकी सेवानिवृत्ति से पहले इस व्याख्यान का आयोजन किया गया। अपने व्याख्यान में श्रीमती छाया ने आईपीआर के विभिन्न प्रभागों में कार्य करने के अपने तकरीबन 4 दशकों की जीवन यात्रा के अनुभवों का निचोड़ प्रस्तुत किया। उन्होंने अपनी इस लंबी अवधि के दौरान के सभी, खट्टे-मीठे अनुभव साझा किये। श्रीमती छाया आईपीआर के शुरूआत के समय से ही आईपीआर से जुड़ी हुई है। उन्होंने आईपीआर की स्थापना के शुरू से ही तकनीकी कार्यों में होने वाली चुनौतियों पर अपने अनुभव उत्साह पूर्वक बताए। व्याख्यान के पश्चात् डॉ. विनय कुमार ने राजभाषा कार्यान्वयन समिति की ओर से श्रीमती छाया को स्मृति के रूप में भेंट प्रदान की। श्री रीज सिंह ने कार्यक्रम के अंत में एक समर्पित सदस्य के रूप में अपनी सक्रिय भूमिका निभाने के लिए श्रीमती छाया की सराहना की और धन्यवाद दिया।



व्याख्यान की झलकियाँ

The 75th Republic Day was celebrated at the IPR main campus on 26 Jan 2024 with full enthusiasm and patriotism. On this occasion, Director IPR received the Guard of Honour from the security staff and unfurled the national flag, followed by the National Anthem.

Director IPR then addressed the gathering of staff members and their families present for the event. His speech was mainly focused on the scientific and technological achievements of the Institute in the previous year. During his speech, he discussed various scientific experiments and technological achievements, these included the Non-Neutral plasma, High-Temperature Superconductor, Neutron and ion irradiation facility, commissioning of ITER-India High Power Gyrotron Test Facility, Raudra—Plasma Pyrolysis System, Lead Lithium Loop, High-Pressure Helium Circulator, and the progress of LIGO India project.

This was followed by snacks and various competitions and fun games for staff and families. Prizes were also distributed to the winners by the Dean R&D, Dr. Paritosh Chaudhuri, which was followed by lunch. The R-Day programs for the staff were coordinated by the IPR Staff Club.



Unfurling of the tricolor and addressing the gathering by Director IPR



Dr. Paritosh Chaudhuri (Dear R&D) Distributing prizes for various Sports Activities



75th Republic Day Celebration @ CPP-IPR



At Center for Plasma Physics (CPP-IPR) Guwahati, the National Flag was unfurled by Shri. P. K. Deka, Accounts Officer and the senior-most member of CPP-IPR staff, who is retiring on January 31, 2024. Dr. B. J. Saikia, Scientific Officer - F delivered a speech on the history and significance of the day.

On the occasion, various sports and cultural events were organized. Employees of CPP-IPR with their family members participated in these events and prizes were distributed to the winners. A few individuals from the adjoining villages also joined in the Republic Day celebration.



Plasma Exhibition @ Thiruvananthapuram (Kerala)

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Institute for Plasma Research (IPR), Gandhinagar (Gujarat), in association with the Rajadhani College of Engineering & Technology (RIET), Attingal (Thiruvananthapuram District), organized an exhibition on Plasma, the fourth state of matter during 11-15 September, 2023. This program is part of IPR's rural scientific outreach activity in the state of Kerala. The programme consisted of an exhibition on plasma, its applications as well as introductory talks on plasma for visiting students. The event was inaugurated by Dr. M. S. Rajashree, Director of Technical Education, Government of Kerala. For this exhibition, 56 engineering students from RIET were trained by IPR team to explain the exhibits to visiting students in their local language. A quiz competition for school students was also organized by IPR during the event. A training program on plasma, its applications and nuclear fusion was also organized for 38 faculty members of RIET. Over 3000 students and general public visited the exhibition at Rajadhani College of Engineering & Technology. The event



View of the exhibition of Plasma and its applications at RIET, Thiruvananthapuram



Inauguration of the event by Dr. M. S. Rajashree, Director of Technical Education, Government of Kerala.



Images from the plasma exhibition held at Rajadhani College of Engineering & Technology, Attingal, Thiruvananthapuram Dt.



Training of volunteers and introduction of plasma to visiting students



Training program in plasma and its applications for teachers



Student volunteers explaining the plasma exhibits to visitors

LIGO-India Vacuum Integrated System Test Assembly (LI-VISTA) facility is currently being setup at LIGO-Lab in IPR for evaluation of 80K Cryopump efficacy in trapping water molecules moving along the length of assembly. It consists of two sub systems – (1) a 20 m long cylindrical integrated vacuum vessel (IVV); (2) 1:1 scale 80K Cryopump (80K-CP) of LIGO.

LIGO Division of IPR has successfully executed the FAT, site installation and testing of 80K Cryopump. The 80K-CP contract comprised of fabrication of vacuum vessel, LN₂ reservoir, passive thermal shield, LN₂ & GN₂ lines, integration with vacuum equipment, operation controls, demonstration of ultra-high vacuum (UHV), supply and installation at IPR. The motivation of this procurement includes assessment of (a) fabrication feasibility of large diameter cylindrical vessel, dished head, annular LN₂ reservoir made of Al annular reservoir and cryogenics lines (b) Assembly of different component in an ISO 8 clean room (c) 80K Cold shock and vacuum testing.

The 80K Cryopump is mainly comprised of SS cylindrical vessel (Inner diameter 2m and length 5.3m), Al annular reservoir (Inner diameter 1.3 m, outer diameter 1.5m and length 3.7m) and Al passive thermal shield (diameter 2m and length 4m). The volume of 80K Cryopump will be maintained at Ultra-High Vacuum (UHV) of $< 1 \times 10^{-9}$ mbar during LIVISTA operation. To achieve this vacuum, a combination of roughing pump, turbo molecular pumps (TMP) and ion pumps are integrated with the outer vessel of this system. Operation of all vacuum equipment is controlled through central control unit capable of remote operation.

The following tests have been performed to verify the compliance with UHV and Cryogenics compatibility of 80K Cryopump assembly (a) UHV compatible cleaning of vacuum exposed surface (b) Individual Joint He leak tightness $< 7 \times 10^{-10}$ mbar.l/s (c) Global He leak tightness $< 2 \times 10^{-8}$ mbar.l/s (d) Cold shock test followed by global leak testing of reservoir and vacuum vessel and (e) achievement of Ultimate Vacuum of 6×10^{-9} mbar.



Images of the installation of the cryo-pump for the LIGO-India VISTA facility at IPR

Academic Visits to IPR During December 2023

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Date	Institution	Visitors
13-Dec-2023	Gajera Global School, Surat	30 students of class 11-12
14-Dec-2023	National Forensic Science University, Gandhinagar	68 student of BTech
15-Dec-2023	Sughad Primary School, Sughad, Gandhinagar	77 students of class 9-10
18-Dec-2023	Koteshwar Prathmik Shala, Koteshwar, Gandhinagar	44 students of class 6-8
19-Dec-2023	Motera Kanya Primary School, Motera, Ahmedabad	71 students of class 6-8
19-Dec-2023	Geetanjali Institute of Technical Studies, Dabok, Rajasthan	48 students of BTech
20-Dec-2023	Sheth N M Patel High School, Rancharda, Gandhinagar	40 students of class 9-11
20-Dec-2023	Hudko Primary School, Bhat, Gandhinagar	61 students of class 6-8
21-Dec-2023	Sarvoday Vidya Mandir (School), Bhat, Gandhinagar	75 students of class 9-10
21-Dec-2023	Bhat Primary School, Bhat, Gandhinagar	75 students of class 7-8



Students and teachers of National Forensic Science University, Gandhinagar, during their visit to IPR



Students and teachers of Gajera Global School, Surat, during their visit to IPR



Students and teachers of Motera Kanya Primary School, Motera, Ahmedabad, during their visit to IPR

Academic Visits to CPP-IPR During January 2024

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Date	Institution	Visitors
4-Jan-2024	Nazirakhat L. Primary School, Kamrup, Assam	24 students and 4 teachers
5-Jan-2024	Mairang Presbyterian Science College, Mairang, Meghalaya	6 B. Sc. students and 4 teachers



Students and teachers of Nazirakhat L. Primary School, Kamrup, Assam, during their visit to CPP-IPR



Students and teachers of Mairang Presbyterian Science College, Mairang, Meghalaya during their visit to CPP-IPR

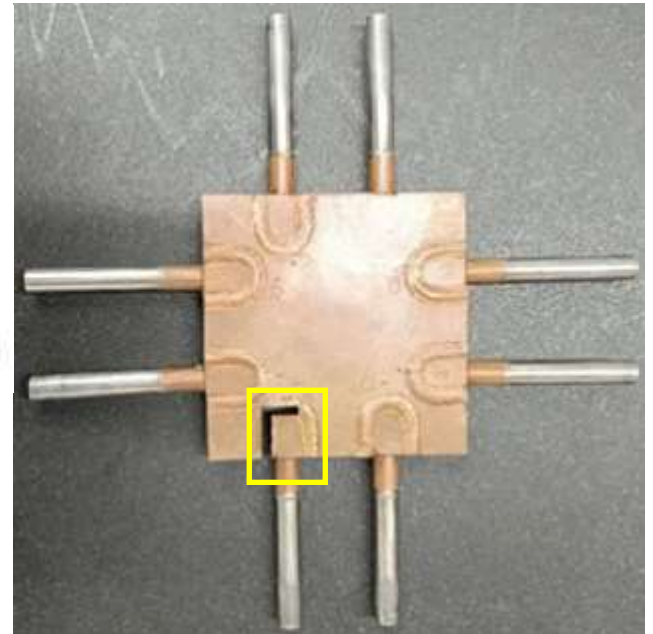
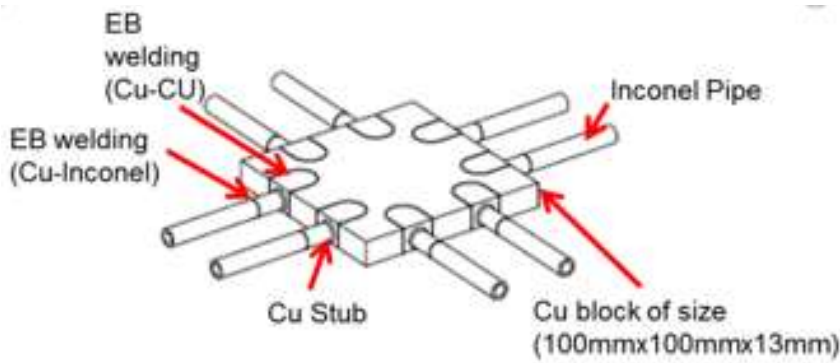
Several systems of fusion devices like neutral beam, divertor and first wall consist of actively cooled components which require dissimilar material welding in full penetration configuration for through thickness weld integrity. For materials like copper / copper alloys, it is not practical to fulfill such requirements with the conventional joining technologies like TIG and laser welding.

Further, the typical processes like friction welding, which has been a candidate since many years for dissimilar material joints especially in case of accelerator grids, has limitations related to orientation, vibrations, effect on machining accuracies required prior to welding, need of post welding machining, requirement of full inspection and no option to repair.

To overcome these limitations, technology of EB welding for was developed by ITER India and protected by IPR under the patent no. US patent No.: US 10,480,863 B2 / Indian Patent No. 481223 / European Patent No. 3424635.

As an effort towards indigenization, activities were initiated to assess the feasibility to replicate the IPR owned technology within Indian industry. The technology developed consists of full penetration butt weld configuration (13mm thick) with tolerances matching the EB welding needs, setting up and fine-tuning of the welding parameters for double sided weld, qualification of the welding process according to international standards along with additional requirements for components functional in radiative environment, assessment of the welding quality / welding integrity through Production Proof Sample (PPS) and its implementation on the production components.

Apart from the destructive and non-destructive testing (100% volumetric examination by radiography), as stipulated by codes, the development confirms the pressure compatibility for 30 bar and Leak tightness for He up to 1×10^{-12} mbar.l/s. The technology in its present form is ready for use in accelerator grids of neutral beam and other systems of fusion devices with similar requirements.



Sample taken for micro examination after finishing



Welded PG prototype segment



Micro examination of the weld joint (Cu-Cu)

The toy tokamak or TOKOTOY as we fondly call it, is an attempt by IPR Outreach to popularize the concept of magnetically confined fusion, *i.e.*, the Tokamak. This oversimplified version of a Tokamak which we term as a "Generic Tokamak" has the major components of a tokamak but devoid of the complicated structures of a real tokamak, thus making it easier to understand the concept of magnetically confined fusion. This "toy" is aimed at high school and UG students who would like to learn more about magnetically confined fusion machines. This 12 component, 35-piece toy can be easily assembled under 10 minutes. The Outreach website has provided online documentation and videos to help in assembly of the toy. This toy is used to teach students about how a tokamak fusion device looks like and some of its major components. A very popular competition to assemble the toy is usually held during IPR's outreach programs and students actively participate in this to compete to become the fastest to assemble the tokamak model ! Read more about it [HERE](#).



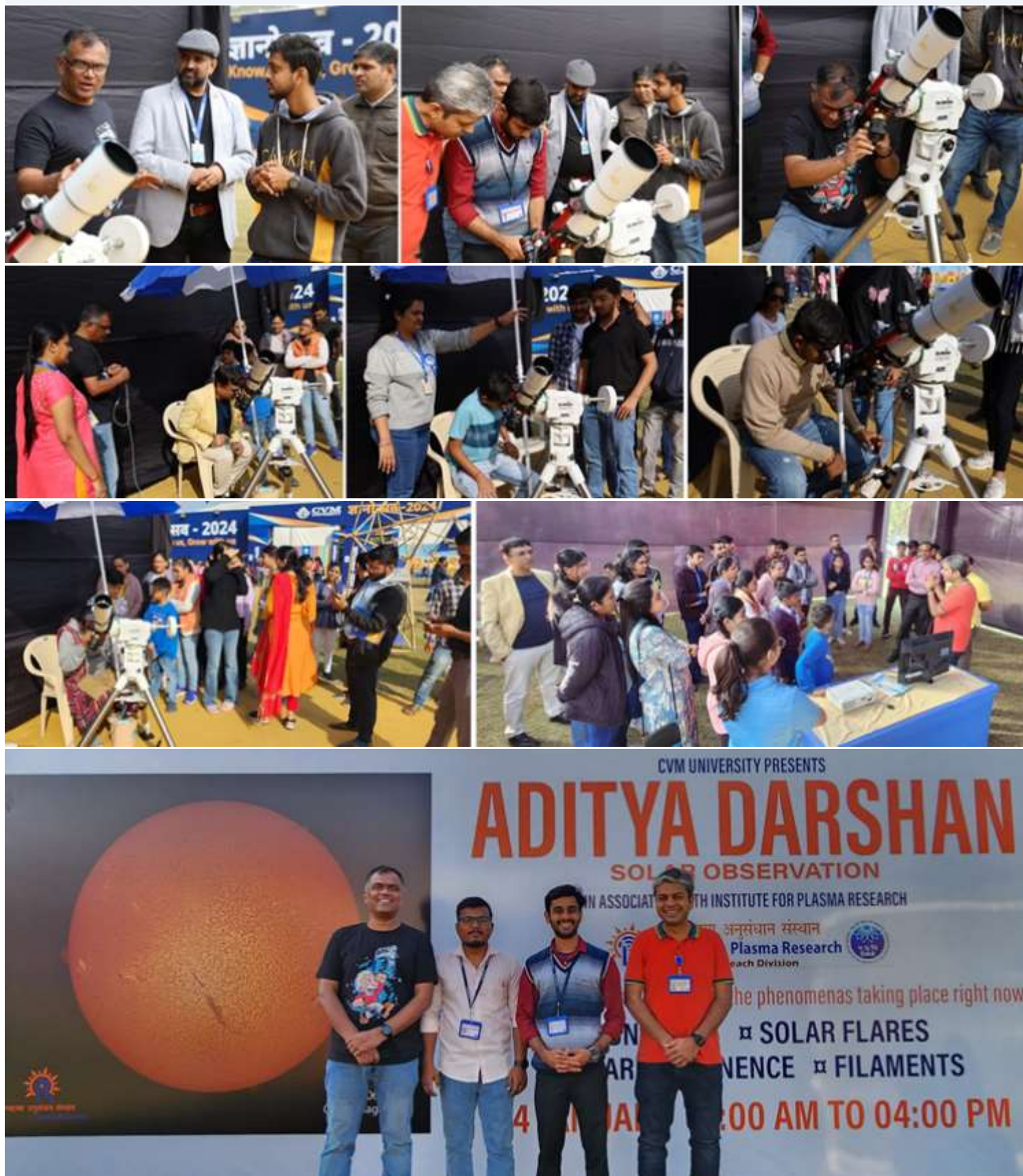
The TokoToy



Students participating in the TokoToy assembly competitions at various outreach events

As part of the 70 Year Platinum Jubilee celebration of DAE, IPR organized a solar observation event at the "Gyanostav 2024". This event was organized by the Charutar Vidya Mandal University, Vallabh Vidyanagar, Anand (Gujarat) on 4th January, 2024 at Vallabh Vidyanagar, Anand (Gujarat). IPR's solar telescope with high resolution H-Alpha filter was used for this event. Students not only viewed the details of the surface of the sun with the telescope, but also were given information about the telescope, solar imaging techniques, H-alpha filters etc, during the course of the event.

Over 1000 students and general public got an opportunity to view the surface of the sun and observe sunspots, filaments, phages and prominences. IPR staff explained these phenomenon as well as the working of the solar telescope with emphasis on how to safely observe the sun to the visitors. The event was coordinated by Dr. Foram Joshi of CVM University. Read more about the event [HERE](#).



Images from the solar viewing event held at CVM University, Anand

संस्थान में 10 जनवरी 2024 को विश्व हिंदी दिवस समारोह का आयोजन किया गया। इस अवसर पर व्याख्यान देने हेतु श्रीकृष्ण गुप्ता, राजा रमन्ना फेलो, उत्कृष्ट वैज्ञानिक एवं पूर्व विशेष कार्य अधिकारी, परमाणु ऊर्जा विभाग को आमंत्रित किया गया था। श्रीकृष्ण गुप्ता ने "भारत के आत्मनिर्भर कार्यक्रम में परमाणु ऊर्जा विभाग का योगदान" विषय पर व्यापक रूप से चर्चा की। उन्होंने बिजली उत्पादन में नाभिकीय ऊर्जा के उपयोग पर चर्चा करते हुए देश को नाभिकीय ऊर्जा की सुरक्षा प्रदान करने में पऊवि के मुख्य लक्ष्य पर प्रकाश डाला एवं पऊवि के नाभिकीय कार्यक्रम के तीन चरणों की विस्तार से जानकारी प्रदान की। उन्होंने नाभिकीय ऊर्जा के उत्पादन में आ रही चुनौतियों और वैज्ञानिकों के बढ़ते दायित्व पर भी ध्यान केन्द्रित किया। श्रीकृष्ण गुप्ता जी ने वर्तमान में देश को आत्मनिर्भर बनाने के लिए अनुसंधान एवं विकास की गतिविधियों के साथ-साथ औद्योगिक क्षेत्रों में उन्नति लाने की आवश्यकता बताते हुए तकनीकी विनिर्देशों के अनुसार उद्योगों को कार्य करने के लिए उत्साहित एवं प्रेरित करने पर जोर दिया। व्याख्यान के पश्चात् उन्होंने पऊवि की गतिविधि पर एक जानकारी पूर्ण एवं ज्ञानवर्धक विडियो भी दर्शकों को दिखाया एवं उनके संदेहों को दूर किया।

धन्यवाद ज्ञापन के पश्चात् श्री राज सिंह ने संस्थान की तकनीकी/वैज्ञानिक एवं सामान्य गतिविधियों पर आधारित एक प्रश्नोत्तरी प्रतियोगिता बहुत ही रोचकता के साथ संचालित की जिसमें सभी श्रोताओं ने उत्साह पूर्वक भाग लिया।



(L) श्रीकृष्ण गुप्ता जी का गुलदस्ते से स्वागत करते हुए डॉ. परितोष चौधरी (R) श्रीकृष्ण गुप्ता व्याख्यान देते हुए



(L) श्रीकृष्ण गुप्ता जी को स्मृति चिन्ह प्रदान करते हुए श्री निरंजन वैष्णव (R) धन्यवाद ज्ञापन देते हुए श्री राज सिंह



सभागार में उपस्थित श्रोतागण



Mr. Rajiv Sharma gave an invited talk entitled "*Thermal Insulation for 80 K Temperature Cryogenic Systems*" was delivered by at the "2nd International Conference on Futuristic Advancements in Materials, Manufacturing, and Thermal Sciences (ICFAMMT 2024)" during 19-21 Jan, 2024 at the Institute of Infrastructure, Technology, Research, and Management, Ahmedabad (IITRAM), jointly organized by the Space Society of Mechanical Engineers (SSME), Ahmedabad, India, and the Department of Mechanical and Aerospace Engineering of IITRAM, Ahmedabad.



Dr. Promod Kumar Sharma gave a talk on "*Design criteria for PAM launcher for SST1 tokamak*" at the National Conference on Emerging Trends in Vacuum Electronic Devices & Applications (VEDA-2023), held at the Godavari Institute of Engineering & Technology (GIET), Rajahmundry, during 23-25 November 2023. He also received the Best Paper Award.



Ms. Manisha Jha gave a talk entitled "*Pattern re-configurability using plasma for beam steering application at S-band*" at the 2023 IEEE Microwaves, Antennas, and Propagation Conference (MAPCON), held at the Forum Celebration Centre, Ahmedabad, during 10-12 Dec 2023. She also received the Shrimati Ranjana Pal Memorial Award for "Best paper in antenna by a woman researcher"

- ◆ **Dr. P. K. Sharma**, gave an invited talk on “Microwave technologies for fusion plasmas at IPR” at Electromagnetics and Microwave Engineering: Pedagogy, Research Trends and Applications Conference (EMPRA-2023), BITS, Pilani, Hyderabad Campus, 1-3 November 2023
- ◆ **Invited talks presented at 38th National Symposium on Plasma Science & Technology (PLASMA 2023), Dehradun, 4-8 December 2023**
 - **Dr. P. K. Sharma**, gave an invited talk on “Evolution of LH Launchers for Tokamaks at IPR”
 - **Dr. Sudip Sen Gupta**, gave an invited talk on “Lagrangian hydrodynamic description of Nonlinear Plasma Waves”
 - **Dr. N Bisai**, gave an invited talk on “On Rotation/spin of Plasma Blob in Edge and Scrape-off Layer Regions”
- ◆ **Talks presented at 33rd Annual Conference & Exhibition on Non Destructive Evaluation & Enabling Technologies, Orchid Hotel, Pune, 7-9 December 2023**
 - **Mr. Mayur Mehta**, gave a talk on “Implementation possibility of 3D Digital Image Correlation in High Heat Flux Test Facility”
 - **Mr. Kedar Bhope**, gave a talk on “Ultrasonic Inspection Technique for He Cooled Plasma Facing Components”
- ◆ **Talks presented at 2023 IEEE Microwaves, Antennas, and Propagation Conference (MAPCON), The Forum Celebration Centre, Ahmedabad, 10-12 December 2023**
 - **Mr. Ravinder Kumar**, gave a talk on “Rapid scanning polarizing Martin Puplett type THz Fourier transform spectrometer (FTS) for ITER ECE measurements
 - **Ms. Varsha Siju**, gave a talk on “Design and Characterization of High Temperature Black Body Source in Microwave-Millimetre wave Spectrum for radiometric calibration
 - **Ms. A. Sarada Sree**, gave a talk on “Digital Video communication using salt water standing columns”
- ◆ **Dr. Santosh Pandya**, gave a talks on “Simulations of Runaway Electrons During Tokamak Startup” and “Modelling of Synchrotron Emission Pattern Emitted by High Energetic Runaway Electrons in Tokamaks” at 16th International Conference on Plasma Science and Applications (ICPSA 2023), University of Lucknow, 12-14 December 2023
- ◆ **Mr. Abhishek Saraswat**, gave a talk on “Design, fabrication and assembly of a two-phase detection sensor array for molten lead (Pb) based heavy metal coolants” at 10th International and 50th National Conference on Fluid Mechanics and Fluid Power, Indian Institute of Technology Jodhpur, 20-22 December 2023
- ◆ **Mr. Sudhirsinh Vala**, gave a talk on “Development of a rotating tritium target based D-T Neutron generator system for fusion neutronics studies” on 22nd December 2023
- ◆ **Talks presented at 67th DAE Solid State Physics Symposium, Gandhi Institute of Technology and Management (GITAM) Visakhapatnam, 20-24 December 2023**
 - **Mr. Amit K. Rana**, gave a talk on “Enhancing the Oxygen Evolution Reaction (OER) Performance by Means of Multi-dimensional Carbon Compounds”
 - **Dr. Amreen A. Hussain**, gave a talk on “Tailored Antisolvent Engineering on CsPbI₃ Perovskite for Black Phase Stabilization at Low Temperature”
- ◆ **Mr. Ravinder Kumar**, gave a talk on “इटर- इंडिया डीआईएस्टिक सिस्टम्स की नवीनतम प्रगति का अवलोकन” at All India Hindi Scientific Seminar (AIHSS-2024), Sarabhai Auditorium, IGCAR, Kalpakkam, Tamilnadu, 10-11 January 2024

Upcoming Events

- ◆ India Energy Week 2024, Goa, India, 6-9 February 2024; <https://www.indiaenergyweek.com/event/2fe24000-628c-4f45-a85e-4e8ed44d433c/summary>
- ◆ Texas Power and Energy Conference (TPEC 2024), Texas, United States, 12-13 February 2024; <http://tpec.engr.tamu.edu/>
- ◆ Workshop on Layering in Magnetized Plasmas (ADIW05), University of York, United Kingdom, 19-23 February 2024; <https://www.newton.ac.uk/event/adiw05/>
- ◆ 2nd FusionX Invest, Boston, Massachusetts Institute of Technology, United States, 21-22 February 2024; <https://www.fusionxinvest.com/fusionxinvest/boston>
- ◆ 5th International Conference on Reliability Safety and Hazard (ICRESH 2024), DAE Convention Centre, Anushaktinagar, Mumbai, 21-24 February 2024; <https://barc.gov.in/symposium/icresh.pdf>
- ◆ Joint ICTP-IAEA Workshop on Modelling for Encapsulated Intermediate Level Waste (ILW) and High Level Waste (HLW) During Long-Term Storage, Trieste, Italy, 26 February - 1 March 2024; <https://indico.ictp.it/event/10458>

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Know Your Colleague



Mr. Ravi Ranjan Kumar obtained his B.E in mechanical engineering from Siddaganga Institute of Technology, Tumkur (Karnataka) in the year 2012. He joined IPR through the Technical Training Program of 2014 (TTP 2014). Since 2015, he has been working with the Remote Handling and Robotics Technology Development Division (RHRTD). He has contributed to the development of various robotics system such as vacuum and high temperature compatible in-vessel inspection system, Hyper redundant inspection system, Haptic forced feedback master arm and several Lab scale RH prototypes. He has been project guide for several project students. He has also developed working models on remote handling for the Outreach Division. He is actively involved in IPR science day and other outreach activities of IPR.

Plasma Exhibition @ Thiruvananthapuram



IPR team with the volunteers from RIET, Attingal, during the Plasma exhibition held at RIET in Thiruvananthapuram

The IPR Newsletter Team

Ritesh Srivastava	Tejas Parekh	Ravi A. V. Kumar	Priyanka Patel	Dharmesh Purohit	Pratibha Gupta	Saroj Das
Suryakant Gupta	Ramasubramanian N.	Supriya R Nair	Shravan Kumar	B. J. Saikia	Harsha Machchhar	Sandhya Dave

Institute for Plasma Research
Bhat, Near Indira Bridge
Gandhinagar 382 428,
Gujarat (India)



Web : www.ipr.res.in
E-mail : newsletter@ipr.res.in
Tel : 91-79-2396 2000
Fax : 91-79-2396 2277