The 4th State

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

Issue 152, March 2026

Swachhata Pakhwada 2026

Swachhata Pakhwada 2026 was observed from 16 February 2026 to 28 February 2026 at the Institute for Plasma Research (IPR) and its extended campuses. The campaign aimed to promote cleanliness, hygiene awareness, and collective responsibility towards maintaining a clean and healthy workplace environment. The Campaign commenced on 16 February 2026 with the Swachhata Pledge, where participants reaffirmed their commitment to maintaining cleanliness and contributing to a hygienic environment. To encourage active participation and spread awareness:

A Selfie Booth was installed at the entrance near the porch, allowing participants to capture and share their commitment to the Swachhata initiative.

A Signature Campaign was organized to motivate employees and visitors to pledge their support for cleanliness. A signature board was placed at the entrance near the porch for this purpose.

Swachhata banners highlighting the importance of cleanliness and sanitation were displayed at various prominent locations across the campus.

The Swachhata Pakhwada campaign was conducted across all four campuses, i.e. IPR, FCIPT, ITER- India and CPP Guwahati, ensuring widespread engagement and participation.

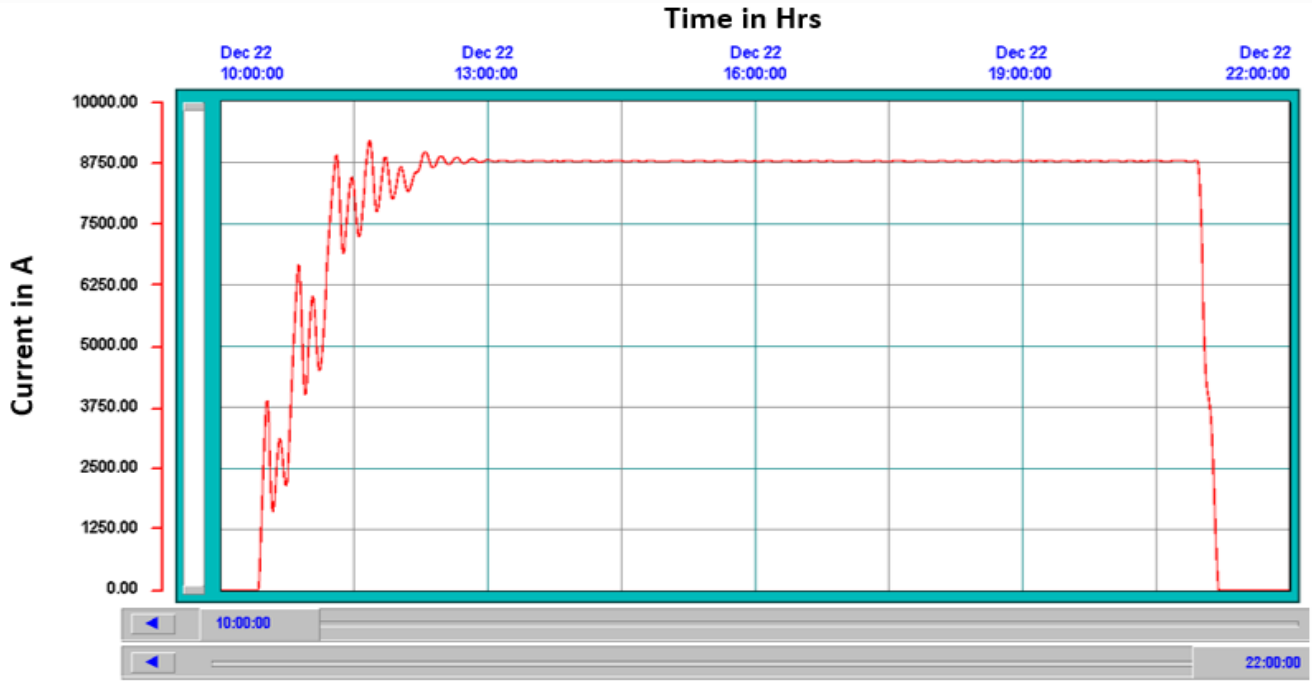
Director, Dr. Tapas Ganguli and ACAO, Ms. Supriya Nair administering the Swachhata Pledge

Swachhata Signature campaign (L). Swachhata Selfie booth (R)

An improved cryocooling with stable and higher TF magnet charging up to 8800 A in SST-1[2]

The SST1 (Steady State Superconducting Tokamak) at IPR has recently seen a turning point with a big jump in performance of cryocooling with superconducting TF (Toroidal Field) magnet charging up to 8800 A continuously for more than 8 hours (Below figure), achieved in plasma campaign no-32 in Dec-2025 compared to the unstable current charging at even below 5000 A and for less than 1 hour in the year 2023. The SST1 has been established for doing plasma experiments, which can be helpful towards making indigenous nuclear fusion reactors to get electricity with a very minimal nuclear radiation and zero greenhouse effect. In this regard, SST1 is an important machine involving many advanced scientific and engineering equipments. It's superconducting magnet system (SCMS) is based on NbTi superconducting material. All 9 PF (Poloidal Field) coils and 16 TF coils of this SCMS are designed to be cooled at ~5 K (about -268^{0}C) using supercritical helium (SHe) as nominal operation with an option of 2-phase helium cooling. The whole SCMS including support structures, superconducting bus bars, current feeder system, cryogenic piping layout has cold mass about 35 tons, which need to be cooled down to about 5 K from room temperature and maintain at this low temperature for few weeks for different plasma experiments. To achieve this, a helium refrigerator-cum-liquefier (HRL) plant having equivalent refrigeration power of 1.3 kW at 4.5 K has been installed and operated successfully since 2003.

Due to high cryogenic heat loads on SCMS within cryostat and other peripheral components outside cryostat, it has been difficult to operate the SST1 with its design values. Since 2013, certain plasma experiments were being conducted with TF magnet current charging up to about 5 kA (nominal value is 10 kA) and magnetic field about 1.5 T. In 2023, this possibility also got reduced due to more heat loads and vacuum got degraded due to higher leaks. Scientists and engineers of IPR again analysed the system and tried to solve these issues. This modification and improvement works started since Mar-2025. After few modifications, which could be done in short time in the system and manipulations in the cryogenic cooling systems operations, a big jump in the cryogenic performance could be observed, when SST1 machine was operated in Dec-2025. Vacuum also showed an improvement with reduced leaks. There were few locations, like unshielded manhole ports of cryostat, unshielded parts of current carrying bus bars in the bus ducts, cryogenic fluid transfer lines, etc. where heat loads were high. Among these only few cryostat ports could be modified to have actively cooled thermal radiation shields. Other modifications are planned for the next phase as they are long time taking. The 2-phase flow of nitrogen in the thermal radiation shield have many parallel paths (58 paths inside cryostst and about 12 paths in different systems outside cryostat). Managing 2-phase flow and thereby maintaining low temperature are not easy. An operational improvement was made so that vapor entering the system is reduced leading to better flow distribution and improved thermal shield cooling. We also enhanced pumping speed of vacuum pumping system of cryostat. Further, the helium plant system could be operated with higher cooling power by manipulating certain process flow parameters. Due to all these, heat load on the SCMS got reduced and HRL plant could provide 2-phase helium to TF coil with higher fraction of LHe. This higher liquid fraction reduced leakage from the TF magnet. Of course, during this operation, all PF coil case cooling paths were bypassed, no helium flow was provided. TF coil current charging up to 8800 A with magnetic field ~2.7 T could be done continuously without quench. On the next day on 23rd Dec-2025, unfortunately there was a quench. The long time taking improvements to reduce heat loads are in process.



The figure showing charging of TF coil at ~9kA for 9 hours

National Science Day 2026

The National Science Day was conducted as an offline event at IPR main campus during 10-11 January 2026. Over 400 students and 150 teachers from 97 schools participated in this 2-day event.

The program was inaugurated by Dr. Tapas Ganguli, Director, IPR. Seven competitive events were conducted in which 38 prizes were awarded. Apart from the competitive events, the NSD also had open house visits to various labs of IPR as well as a solar observation event using the high resolution solar telescope of IPR outreach. Around 200 students and 12 teachers participated in the science model competition. NAND VIDYANIKETAN, Jamnagar was awarded the IPR NSD 2026 Rolling trophy for scoring the maximum points in the competitive events.

Over 2000 people visited IPR during the two-day scientific extravaganza.

National Science Day 2026

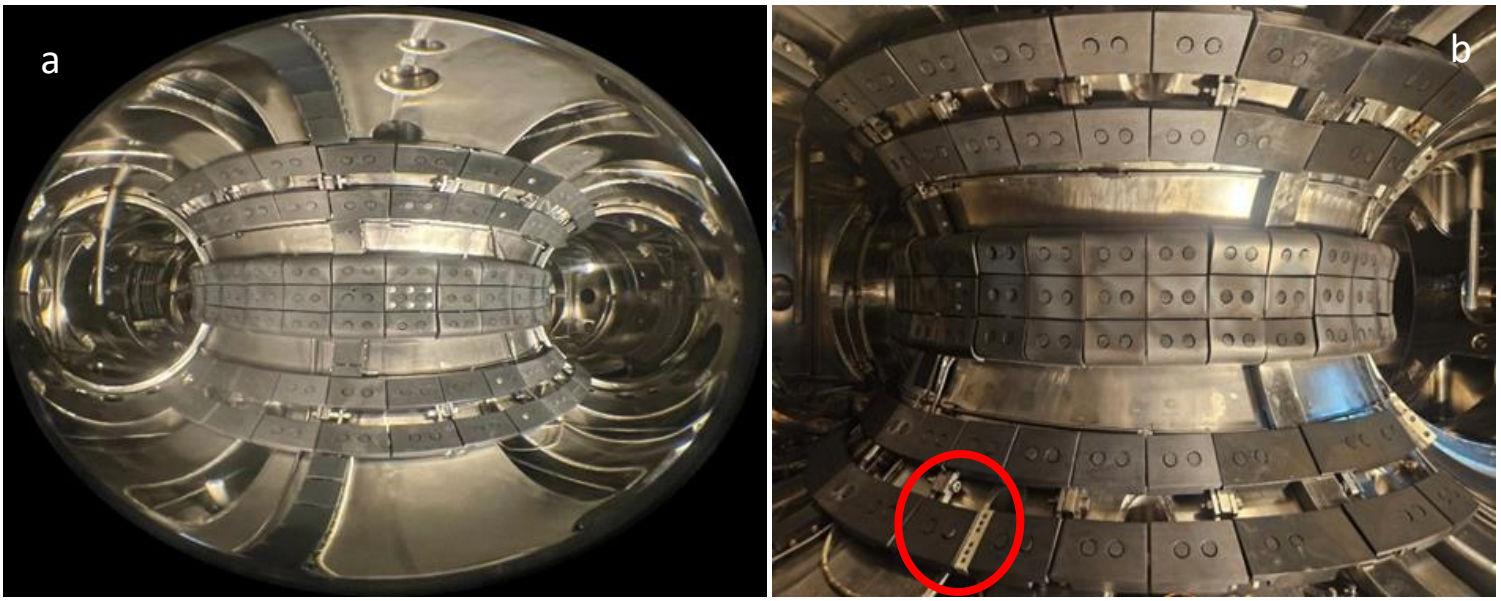
Glimpses of the National Science Day 2026 at IPR

Installation of Divertor-tiles in the ADITYA-U Tokamak

One of the primary goals of the ADITYA-U tokamak program is to achieve shaped plasma operation using a divertor configuration. To facilitate this objective, it is essential to install graphite plasma-facing tiles in the divertor region. After completing the design and simulation processes for the interfacing tiles (which include divertor tiles with in-vessel assemblies such as magnetic diagnostics and safety limiters), the fabrication of the specialized divertor tiles was successfully conducted at the IPR Workshop. Before installation, these graphite tiles underwent comprehensive vacuum-conditioning procedures. The standard vacuum protocol was adhered to, which involved cleaning the tiles with an ultrasonic cleaning that effectively removes porous carbon dust and other loosely bound contaminants. Subsequently, these tiles were baked at 1000°C while maintaining a vacuum of less than 1.0E-5 torr in a vacuum furnace.

Following the assembly of Phase-1 plasma facing components (including the toroidal limiter at HFS, safety limiters, and poloidal limiter), installation of divertor tiles were carried out in subsequent stages. Some divertor tiles were installed in first two phases, which covered ~30% of total area of the divertor-tile coverage in ADITYA-U. Recently, during a major vacuum break in ADITYA-U, the installation and expansion of Plasma-Facing Components in the divertor region were carried out, increasing divertor-tile coverage to approximately 75%, utilizing around 104 graphite tiles and interfacing with various in-vessel structures, including diagnostics. The tiles were specially modified for effective interfacing. One of the divertor-tiles also includes flush-mounted Langmuir probes (indicated in RED circle) to analyze divertor plasma characteristics, especially during shaped-plasma experiments.

A detailed design of limiter and divertor of ADITYA-U has been summarized in the recently published paper “Design, Construction, Integration and Installation of Plasma Facing Components of Limiter & Divertor of ADITYA-U Tokamak” authored by K.M. Patel, et. al., published in Fusion Engineering and Design, Volume 222, January 2026, 115520 https://www.sciencedirect.com/science/article/pii/S0920379625007161

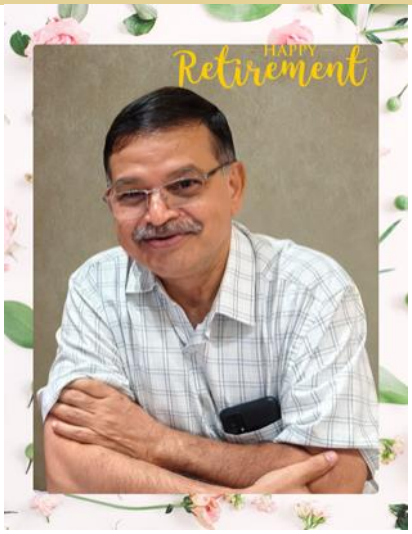


Toroidal-poloidal view of ADITYA-U (Figure a) showing the installed Divertor plates along with toroidal belt limiter and the Flush Langmuir probe (Figure b) highlighted by red-circle.

Superannuation

Shri Ujjwal Baruah, Outstanding Scientist & Project Director ITER-India got superannuated from IPR on 28 Feb 2026 after more than 30 years of service.

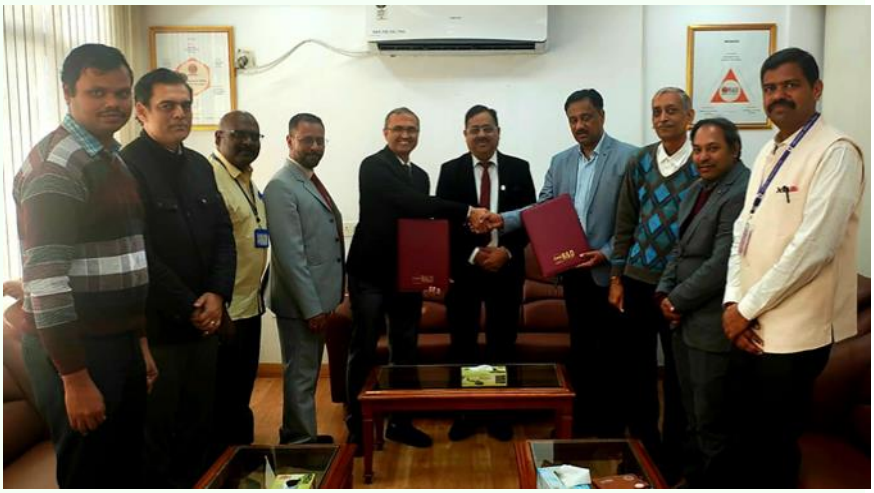
IPR wishes him a very Happy and Healthy retired life.



AIC-Plasmatech and Indian Oil Corporation collaborates for RAUDRA

AIC-Plasmatech, the technology translation and commercialization arm of IPR has been working on field validation and deployment of IPR's indigenously developed RAUDRA Plasma gasification technology for waste-to-energy and waste to hydrogen applications. After detailed round of discussions, a Memorandum of Understanding (MoU) was signed between Indian Oil Corporation acting through its R&D Centre and AIC-IPR Plasmatech Innovation Foundation for development of RAUDRA plasma gasification system for waste-to-energy applications.

Under this collaboration, IOCL and AIC-IPR will jointly work on developing and installing a RAUDRA Plasma gasification system, which will be used for generation of valuable waste-to-energy data, including the amount of hydrogen that can be generated from different waste streams such as MSW, plastic waste, RDF etc. The MoU was signed on 22-January-2026 at IOCL R&D Centre, Faridabad. Dr. Nirav Jamnapara, Dr. Kaushik Choudhury and Mr. P. Vadivel Murugan from AIC-Plasmatech & IPR were present in the meeting along with Shri Alok Sharma, Director, IOCL R&D Centre and other team members including senior officials of IOCL. The project aims to be an example in demonstrating the worthiness of RAUDRA Plasma gasification system for waste-to-hydrogen applications.



Teams from IPR AIC-Plasmatech and Indian Oil Corporation during the signing of MoU

Achievement - ITER Star Award

Three of our ITER-India colleagues—Bikash Ranjan Dash, Bhavin Raval, and Vinit Shukla —have been selected for the 'ITER Star Award' for 2025. This Public Recognition Award, initiated by ITER in 2023, is held for the second time to ITER staff in recognition of their efforts in categories such as Collaboration, Accountability, Respect, and Excellence, either through specific achievements, behaviors, or values. IPR congratulates all these Star Award winners on this well-deserved honor!

Bikash Ranjan Dash, Working in ITER-India Cryogenics Group as an I&C Engineer, contributing to the design, manufacturing, execution, and inspection of control cubicles and software logic development for the ACBs and TSCS. Additionally, responsible for the preparation of I&C diagrams, software development, and field-testing activities for the ITER Magnet Cold Test Bench (MCTB) vacuum system.

Bhavin M. Raval is an Electrical Engineer with the ITER-India Power Supply Group and is currently deputed to the ITER Organization as the TRO for the EC HVPS systems. His key contributions span the entire project lifecycle, covering design verification, integration, manufacturing, installation, compliance verification and commissioning of HVDC system.

Mr. Vinit Shukla is working in the ITER-India Cryogenic Group as a TRO for the ITER Cryo-distribution and Cryo-line systems. His areas of specialization include Mechanical Engineering, Cryogenics, and Process Engineering, with particular expertise in dynamic process simulations. His main contributions encompass the design, manufacturing follow-up, acceptance testing, and successful delivery of the ITER cryo-distribution boxes, plays key role in ensuring compliance with ITER functional and performance requirements.

Academic Visits to IPR

Date	Institution	Visitors
20 Jan 2026	Nirma University, Ahmedabad	84 Students, B. Tech. Electrical Engineering, Sem 4
20 Jan 2026	Nirma University, Ahmedabad	69 Students, B. Tech. Electrical Engineering, Sem 4
30 Jan 2026	L.D. College of Engineering, Ahmedabad	69 Students, B. Tech. Electrical Engineering, Sem 4
30 Jan 2026	Gujarat Arts & Science College, Ahmedabad	45 Students, B.Sc (Phyiscs), Sem 6 & 4
02 Feb 2026	Pandit Deendayal Energy University, Gandhinagar	35 Students, B.Sc (Phyiscs), Sem 2 & 4
11 Feb 2026	Indoscience, Pune	44 Students, Class 7-9
12 Feb 2026	Ganpat University, Ahmedabad	17 Faculty
13 Feb 2026	University of Rajasthan, Dept. of Physics	17 Students, BSc. & MSc. Physics

Academic Visits to CPP-IPR

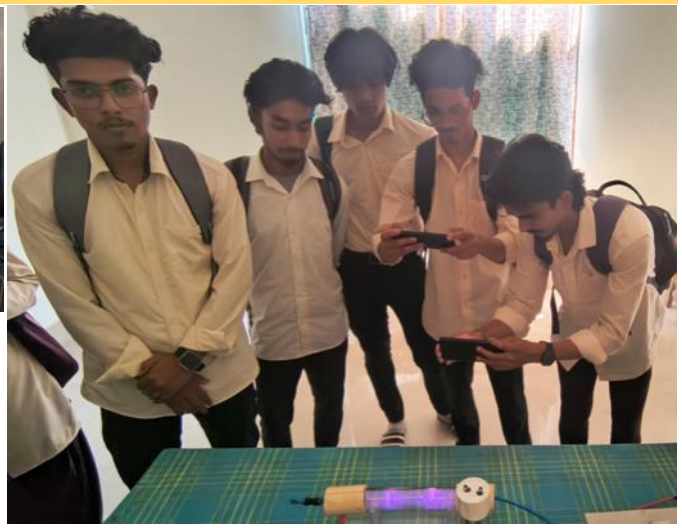
41 students and 2 faculty members from Department of Electrical Engineering from Girijananda Chowdhury University, Assam visited CPP-IPR on 12 Feb 2026.

Group photo of the students from Girijananda Chowdhury University, Assam

CPP-IPR Outreach Programme at Tihu College, Assam

A “Workshop on Plasma Physics” was conducted by CPP-IPR’s Outreach Cell at Tihu College, Tihu, Assam on 20th February, 2026. The workshop was attended by 11 faculties and 32 students of the Physics Department of the college. Dr. Rakesh Moulick and Dr. Ngangom Aomoa gave talks on various aspects of plasma physics followed by live demonstration of glow discharge plasma, arc plasma, Jacob’s ladder and a plasma globe.

CPP-IPR Outreach Programme at Tihu College, Assam



Photos of the Outreach Programme at Tihu College, Assam

Conference Presentations

Mr. Akshay Vaid, gave an invited talk on the topic "Plasma Medicine: Tailoring Plasmas for Healthier Generation in the era of Viksit Bharat" at 8th Nirma Institute of Pharmacy International Conference (NIpiCon-26): Transforming Healthcare: New Horizons in Pharmaceutical Sciences for Viksit Bharat, Nirma University, Ahmedabad, 29-31 January 2026

Mr. Akshay Vaid receiving the appreciation for his invited talk

Dr. Mukesh Ranjan, gave an invited talk on the topic "Low Energy Ion Surface Modification for water harvesting" at International Conference -cum-Round Table on Translational Research and Innovation in Beam Technologies (ICTRIBT-2026), Central University of Himachal Pradesh, 13-15 February 2026

Dr. Mukesh Ranjan giving the talk and receiving the appreciation for his invited talk

Conference Presentation Award

Mr. Ravi Pandey, gave a poster presentation on “Process Development and Qualification of Ceramic Coatings on Copper Coils” at International Cold Spray Conference & Expo 2026, Indian Thermal Spray Association, IIT Madras, Chennai, 23-25 January 2026, and received **Best Poster Presentation Award.**

Mr. Ravi Pandey (3rd from left) receiving the award

Past Events @ IPR

- ***Mr. Umesh Nagora,*** gave a talk on "Density evolution studies during plasma formation and current flat-top phases in ADITYA-U tokamak using Microwave Interferometer" on 22nd January 2026
- ***Dr. Neelam Kumari Arya,*** gave a talk on "Collisional–Radiative Modeling of Low-Temperature Hydrogen Plasmas for Negative Ion Sources" on 23rd January 2026
- ***Dr. Aadil Rashid,*** gave a talk on "Development of integrated Spectral database for ITER X-ray Crystal Survey (XRCS) Spectrometer" on 23rd January 2026
- ***Prof. Tarak Nath Dey,*** IIT-Guwahati, Guwahati, gave a talk on "Coherent Control of Big Quantum Systems: A New Era in Physics" on 23rd January 2026 (***Colloquium #349***)
- ***Dr. Navin Sharma,*** gave a talk on "Floating-Electrode Based Microwave Plasma Jet Source: Study from Plasma Characterization to Societal and Fusion Material Applications" on 27th January 2026
- ***Talks presented at 5th Conference on Plasma Simulation (CPS-2026), Indore, 29-31 January 2026***
  - ***Mr. Amardas Alli,*** gave a talk on "Simulation of Hydrogen helicon plasma source for negative NBI applications"
  - ***Ms. Yashshri Patil,*** gave a talk on "Magnetized Plasma Discharge Modeling and Device Design Optimization Using COMSOL Multiphysics"
- ***Dr. Debrup Mukhopadhyay,*** gave a talk on "Multimodal Diagnostic implementation in ROBIN ion source" on 02nd February 2026
- ***Mrs. Manisha Jha,*** gave a talk on "Design, Development, and Experimental Validation of Reconfigurable Plasma-Based Array Antennas for Improved Gain and Wideband Performance" on 06th February 2026
- ***Dr. Braj Kishore Shukla,*** gave a talk on "ECRH in plasma and 82.6GHz-400kW ECRH system on Tokamak SST-1" on 10th February 2026
- ***Dr. Shilpa Singh,*** gave a talk on "Cold Plasma Oxidation of Copper" on 13th February 2026
- ***Ms. Yashshri Patil,*** gave a talk on "APPEL Linear Device: A Test-bed for Tokomak plasma studies" at International Conference-cum-Round Table on Translational Research and Innovation in Beam Technologies (ICTRIBT-2026), Central University of Himachal Pradesh, 13-15 February 2026
- ***Mr. Abhishek Saxena,*** gave a talk on "Moderator Assembly Design for Multi-isotope Production using high-yield D-T Neutron Generator" on 19th February 2026
- ***Shri Tejas Parekh,*** gave a talk on "Assessing Innovation Readiness for transition of technologies from Lab to Market" on 19th February 2026
- ***Dr. Mayur Kakati,*** gave a talk on "Origin and progress of controlled plasma fusion relevant, plasma surface interaction (PSI) research, at the CPP-IPR CIMPLE-PSI laboratory" on 24th February 2026
- ***Ms. Geethika B R,*** gave a talk on "Spectroscopic Study of Polarized Emission from Laser Produced Plasma and Its Manifestations" on 26th February 2026

Upcoming Events

- TITANS 4th Tritium School, Madrid, Spain, 2-6 March 2026; https://titans-project.eu/2025/09/08/4th-tritium-school-madrid-2026/
- Open Source Software for Fusion Energy (OSSFE) Conference, Munich, Germany, 10-12 March 2026; https://ossfe.org/OSSFE_2026/
- APS Global Physics Summit 2026, Denver, USA and online, 16-20 March 2026; https://summit.aps.org/
- Workshop for Experimental Data Mapping in IMAS, ITER Organization, Europe, 16-20 March 2026; https://indico.iter.org/event/732/
- Fusion Industry Association Annual Policy Conference 2026, Washington, D.C., USA, 18-19 March 2026; https://www.fusionindustryassociation.org/fia-annual-conference-2026/
- Passive Systems Performance and Reliability Workshop, Paris, France, 30 March - 1 April 2026; https://oecd-nea.org/jcms/pl_109806/passive-systems-performance-and-reliability-workshop

विश्व हिंदी दिवस समारोह

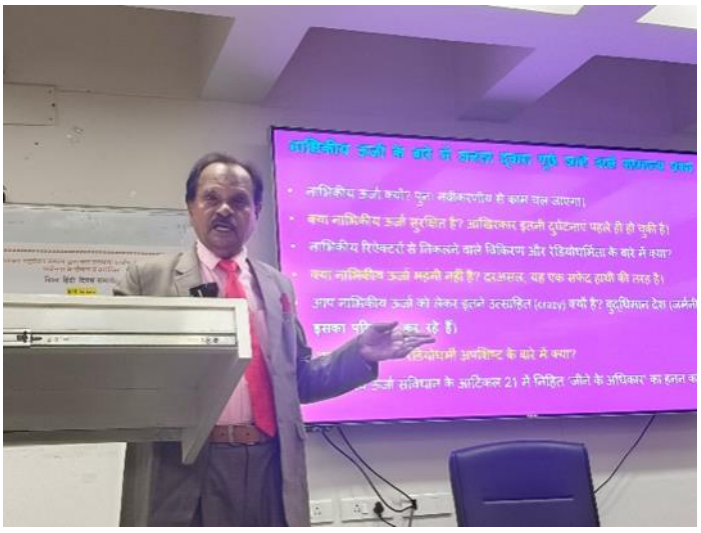
विश्व हिंदी दिवस के उपलक्ष्य में दिनांक 12 जनवरी 2026 को सुबह 11 बजे हिंदी प्रश्नोत्तरी का ऑनलाइन माध्यम से आयोजन किया गय। हिंदी प्रश्नोत्तरी में राजभाषा हिंदी, व्याकरण, संस्थान की गतिविधियों पर आधारित प्रश्न पूछे गये, जिसमें आईपीआर के 105 स्टाफ सदस्यों ने उत्साहपूर्वक भाग लिया। इसी दिन दोपहर को सेमिनार हॉल में *"विकसित भारत (2047) तथा नेट शून्य उत्सर्जन (2070) की लक्ष्य प्राप्ति में नाभिकीय ऊर्जा का योगदान"* विषय पर एक विशिष्ट हिंदी व्याख्यान का आयोजन किया गया। इस अवसर पर श्री स्वप्नेश कुमार मल्होत्रा, उत्कृष्ट वैज्ञानिक एवं पूर्व प्रमुख, जन जागरूकता प्रभाग (परमाणु ऊर्जा विभाग) मुख्य वक्ता के रूप में उपस्थित रहे। कार्यक्रम के प्रारंभ में संस्थान की राजभाषा कार्यान्वयन समिति के नवनियुक्त सह-अध्यक्ष डॉ. सूर्यकान्त गुप्ता ने श्री स्वप्नेश कुमार मल्होत्रा का स्वागत किया एवं उनका संक्षिप्त परिचय प्रस्तुत किया।

श्री स्वप्नेश कुमार मल्होत्रा ने अपने व्याख्यान में भारत के दीर्घकालिक विकास लक्ष्यों, ऊर्जा आवश्यकताओं तथा जलवायु परिवर्तन की चुनौती के संदर्भ में नाभिकीय ऊर्जा की भूमिका को सरल, तथ्यात्मक एवं वैज्ञानिक दृष्टिकोण से प्रस्तुत किया। उन्होंने बताया कि वर्ष 2047 तक भारत को विकसित राष्ट्र बनाने तथा वर्ष 2070 तक नेट शून्य कार्बन उत्सर्जन का लक्ष्य प्राप्त करने के लिए बड़े पैमाने पर स्वच्छ, भरोसेमंद और कम उत्पादन लागत वाले ऊर्जा स्रोतों की आवश्यकता होगी। इस संदर्भ में नाभिकीय ऊर्जा की उच्च ऊर्जा घनत्व, न्यूनतम भूमि आवश्यकता, कम कार्बन उत्सर्जन तथा निरंतर विद्युत आपूर्ति क्षमता पर विस्तार से प्रकाश डाला गया। उन्होंने मानव विकास सूचकांक (HDI) और प्रति व्यक्ति विद्युत खपत के आपसी संबंध को रेखांकित करते हुए स्पष्ट किया कि भारत की बढ़ती आर्थिक एवं सामाजिक आवश्यकताओं की पूर्ति के लिए नाभिकीय ऊर्जा का योगदान अपरिहार्य है।

व्याख्यान में भारत के नाभिकीय ऊर्जा कार्यक्रम, वर्तमान एवं भावी नाभिकीय क्षमता, निजी क्षेत्र की संभावित भागीदारी, नियामक एवं कानूनी सुधारों, अपशिष्ट प्रबंधन, सुरक्षा मानकों तथा जनस्वीकृति जैसे महत्वपूर्ण पहलुओं पर भी चर्चा की गई। इसके अतिरिक्त, नाभिकीय संलयन के क्षेत्र में अंतर्राष्ट्रीय एवं भारतीय उपलब्धियों, जैसे SST-1, ईटर एवं भावी DEMO रिएक्टर, का उल्लेख करते हुए भविष्य की संभावनाओं को रेखांकित किया गया। नाभिकीय ऊर्जा को लेकर आम जनता के मन में प्रचलित भ्रांतियों—सुरक्षा, लागत, विकिरण एवं अपशिष्ट का वैज्ञानिक तथ्यों और वैश्विक अध्ययनों के माध्यम से तार्किक समाधान प्रस्तुत किया गया।

यह व्याख्यान श्रोताओं के लिए अत्यंत ज्ञानवर्धक एवं प्रेरणादायी सिद्ध हुआ, जिससे नाभिकीय ऊर्जा के प्रति वैज्ञानिक समझ एवं सकारात्मक दृष्टिकोण विकसित हुआ। कार्यक्रम ने विकसित भारत एवं जलवायु लक्ष्यों की प्राप्ति में नाभिकीय ऊर्जा की अनिवार्य भूमिका को स्पष्ट रूप से स्थापित किया।

श्री स्वप्नेश कुमारजी को पुष्प गुच्छ देते हुए डॉ. सूर्यकान्त गुप्ता



व्याख्यान देते हुए श्री स्वप्नेश कुमार मल्होत्रा

श्री स्वप्नेश कुमार मल्होत्रा जी को स्मृति चिन्ह भेंट करते हुए डॉ. राज सिंह

व्याख्यान के दौरान उपस्थित श्रोतागण

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Books Exhibition at IPR

IPR Library organized a Books Exhibition on 05 February 2026. Books on the areas of interest of the Institute and few books on general interest were exhibited.

The staff had an opportunity to explore the exhibition and recommend books for the library. They also had the opportunity to buy personal books. Many staff and research scholars visited the exhibition and recommended books for the library.




Staff and Research Scholars visiting the Books Exhibition at IPR Library

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