

Issue 140
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The 4th State

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



Honorable PM's Visit to ITER HQ, France

12th February 2025 was a historic day for ITER as two heads of states visited the ITER construction site together. Shri Narendra Modi, Prime Minister of India and Mr. Emmanuel Macron, President of France spend a considerable time at the site to celebrate one of the biggest human collaborative effort in the fields of Science and Technology. The special guests were welcomed by Dr Pietro Barabaschi, Director General (DG) of ITER along with Shri U.K. Baruah, Project Director, ITER-India.

The guests along with the delegations from the two countries were taken around the site by the DG. The challenges in the project of integrating the various parts, which were manufactured in different continents, with a high precision were highlighted to the guests by DG as well as the senior ITER project staff. The DG also mentioned that during the past year at ITER, the project has comprehensively met all of its objectives related to executing repairs on major components, achieving milestones, and meeting cost performance index targets. "You have come at a good time," he quipped. "I'm glad you are here."

The visiting heads of state showed keen interest in the developments of ITER which is also considered as a "model of science diplomacy in challenging times" for which the entire world should be proud of.

On social media a few hours later, Prime Minister Modi complimented the team working on the ITER project, calling it "a commendable step toward sustainable and limitless clean energy for the future".



Project Director ITER India, Shri Ujjwal Baruah presenting a memento to the honorable Prime Minister Shri Narendra Modi. Titled "Collaboration," or "सहयोग (Sah-yog)", the 3 D printed SS316 model has maps of France and India placed within a circle symbolizing the cryostat—the world's largest vacuum chamber and one of India's major contributions to the project. Model Courtesy: ICPS, an ITER engineering supplier. (Photo Courtesy: ITER Organization)



Prime Minister of India Shri Narendra Modi and President of France Emmanuel Macron at ITER site (Photo Courtesy: ITER Organization)



Director-General Barabaschi is explaining why ITER needs to be so big. "Not out of some megalomania," he said, "but because of technical constraints linked to the goal of creating a burning plasma." (Photo Courtesy: ITER Organization)



Approximately 200 Indian staff members making memory with honorable Prime Minister, Shri Narendra Modi and President Emmanuel Macron in front of the cryostat lid, an Indian contribution to ITER. The 665-tonne component will close the cryostat after the vacuum vessel and major magnet systems have been installed and assembled. (Photo Courtesy: ITER Organization)



Macron and Modi tour ITER together (Video Courtesy: ITER Organization <https://www.iter.org/videos?id=30356>)

IPR Governing Council Chairman and Secretary DAE, Dr. Ajit Kumar Mohanty, visited IPR on February 24, 2025. During his visit, he held a technical meeting with senior IPR faculty.

As part of the discussions, Dr. Indranil Bandyopadhyay delivered a presentation on “Indian Fusion Program—Present Status and Roadmap”, covering ADITYA-U and SST-1. This was followed by a presentation by Sri Anil Bharadwaj on “SST-1 Key Issues and Path Forward”. Dr. Sudhir Kumar Nema then provided a status update on the installation of the RAUDRA plasma pyrolysis system in Varanasi.

Dr. Mohanty addressed the IPR faculty with inspiring words, outlining the future direction and roadmap for the success of the Indian Fusion Program with SST-Bharat. He also encouraged IPR faculty to work with renewed enthusiasm toward the revival of SST-1.

Following the technical discussions, Dr. Mohanty interacted with research scholars, motivating them to contribute actively to the progress of India's fusion energy initiatives.



Dr P Chaudhuri, Dean (R&D) welcoming the Chairman and gave an introduction



Sitting (from L-R) Dr D K Aswal, Director IPR, Dr A K Mohanty, Secretary DAE, Mr U Baruah, ITER-IN PD & Dr S Mukherjee, Dean (Admin)



Dr. Indranil Bandyopadhyay (L) Mr. Anil Bharadwaj (C) and Dr. S K Nema (R) giving their presentations



Dr. Mohanty addressing the staff



IPR Staff members attending the meeting



Dr Aswal and Dr Mohanty interacting with the Research Scholars



Group Photo of the Research Scholars with the AEC Chairman

'ITER Star Award' for 2024

Three of our ITER-India colleagues—Himanshu Kapoor, Anuj Kumar Garg, and Aditya Prakash Singh—have been selected for the 'ITER Star Award' for 2024. 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, behaviours, or values. IPR congratulates all these Star Award winners on this well-deserved honor!



Himanshu Kapoor, Technical Responsible Officer for ITER Cryolines and warmlines under INDIA scope. He is also involved in providing his technical expertise for execution of the design and manufacturing of the cryolines needed for magnet cold test bench facility at ITER site.



Anuj Kumar Garg, I&C Responsible Officer for the ITER-India Cryo-Distribution system, is currently working on the design, manufacturing, execution, and inspection/acceptance of Control Cubicles for Auxiliary Cold Boxes and TSCS, as well as software Task agreement activities for the ITER Magnet Cold Test Bench (MCTB).



Aditya Prakash Singh is currently responsible for preparing Engineering Work Packages for the installation of the ITER Cooling Water System networks inside the Tokamak Complex and auxiliary buildings, as well as for the qualification and procurement of safety-important components.

A first principles study of convection cells to shear flow instability in 2D Yukawa liquids driven by Reynolds stress 5

Convection cells are ubiquitous in nature including Tokamaks. In view of their universality, several hydrodynamic studies on the instability of convection cells to shear flows have been conducted in the past.

This work establishes the first ever quantitative "first principles" based relationship between the formation of shear flows and Reynolds stress starting from kinetic-level convective cells, without resorting to any free parameters. For elongated convective cells, Reynolds stress estimates obtained directly from molecular dynamics data is shown to be the cause for formation of shear flows via tilting instability. In this work, Yukawa liquid is considered as the working medium to facilitate possibilities of verifying our findings in laboratory Complex plasma experiments.

Authored by Pawandeep Kaur & Rajaraman Ganesh, the work is published in [Nature Scientific Reports, 15, 3316 \(2025\)](#)

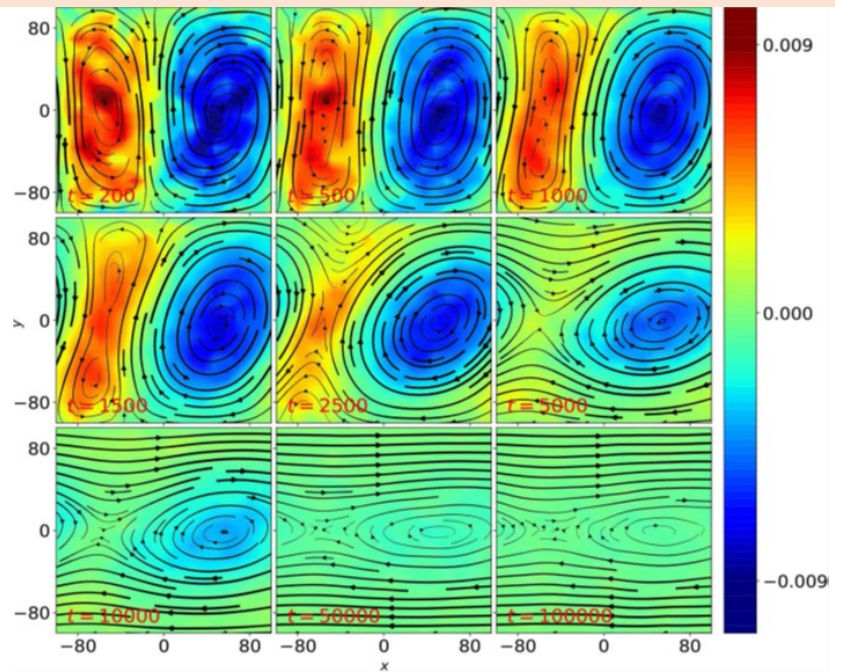


Figure: Snapshots at different times, t representing macroscale fluid flow transition from elongated convective cells to shear flow via tilting instability in a 2D system of Yukawa liquids, where ratio of system's length to its height is unity.

Numerical Design and Experimental Characterization of Reconfigurable Leaky Wave Plasma Antenna

The work presents the design, development and characterization of a leaky wave plasma antenna at 2.45 GHz which has potential application in non-civilian or defense Wi-Fi, in areas where a continuous change in frequency is required. The design of the cylindrical plasma antenna is optimized by varying the plasma tube and ground cylinder dimensions to achieve better impedance matching (S11) of the antenna.

Furthermore, the axial length of the plasma generated inside the tube is directly proportional to the input excitation power, which also determines the plasma resonant frequency, making it possible to fine-tune the resonant frequency.

There are two key achievements of the work that represents a substantial improvement over prior designs and previously reported results. First, the designed antenna achieves an enhanced directivity of 4.31 dBi, coupled with a broad bandwidth of 441 MHz at 2.45 GHz. Second, and most notable, the antenna attains a high radiation efficiency of 73.8%. These advancements underscore significant contributions to the field of plasma antenna technology. The designed plasma antenna is fabricated and characterized experimentally to determine its resonant frequency and scattering parameters. A 10 KHz AC power supply is used for plasma generation inside the tube. The experimental results obtained are consistent with the simulation results.

Authored by Rasila R. Hirani, Abhishek Sinha, Ajay K. Pandey, Surya K. Pathak, Shweta N. Shah, the work is published in [IEEE Access, Volume 12, 2024, 152347](#)

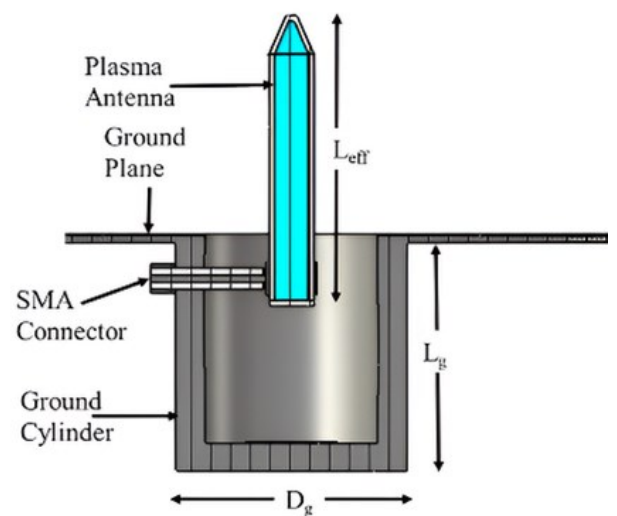


Fig. 1 : Schematic diagram of the plasma antenna used in simulation

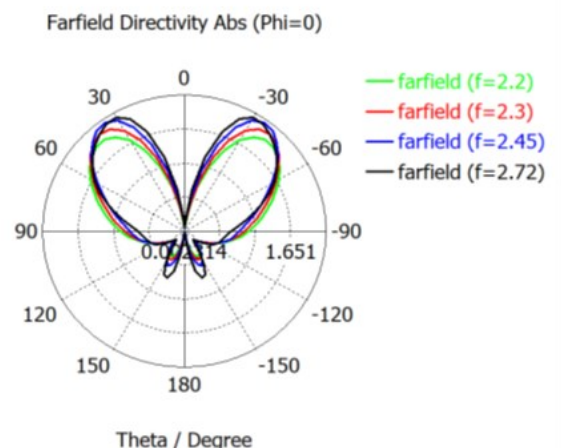


Fig. 2 : 2-D polar plot of the plasma antenna

One Day Seminar on Surface Modification using Plasma Technologies (SMPT-2025)

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As a part of ongoing efforts for commercializing plasma-based technologies, Institute for Plasma Research and AIC-IPR Plasmatech Innovation Foundation, in association with Gujarat Chamber of Commerce & Industries (GCCI) have organized One Day Seminar on the theme “Surface Modification using Plasma Technologies (SMPT-2025)” on 4th February 2025 at FCIPT, Gandhinagar. The aim of the seminar was to give a platform to researchers and industries for showcasing their ongoing activities and results in the field of surface modification using plasma-based technologies. The topics covered in the seminar were Plasma Nitriding, Plasma carburizing process, Plasma assisted physical and chemical vapour deposition, Nano textured surfaces for super hydrophobicity, Plasma surface modification of textiles and polymers and Plasma surface modification for agricultural applications etc.

The seminar was inaugurated by the Chief Guest Shri. R.D. Barhatt, Joint Commissioner of Industries, Government of Gujarat, and the Guest of Honor was Shri. Rajeshbhai Gandhi, Senior Vice-President, GCCI. In the inaugural session, the guests were felicitated by Dean (Admin), Dr. S. Mukherjee, and Dean (R&D) Dr. Paritosh Chaudhuri. There were total 02 sessions held on plasma surface modification for various applications. One additional session covered the funding opportunities for startups, AIC-IPR and Incubation at AIC-IPR etc. Around 60 participants from industries, universities, research institute participated in this event. There were 12 invited talks (06 from outside + 06 from IPR) in the seminar. After the technical sessions, panel discussion was organized where delegates representing from industries, academic institutes, start up, actively interacted with the audience and gave valuable feedback and suggestions. A Lab visit was conducted after the panel discussion.



Felicitatation of the Chief Guest by Dr. S. Mukherjee

Inaugural address by the Chief Guest (L) and the Guest of Honor (R)



Audience attending at the Seminar



Industry feedback during Panel discussion at the end of the Seminar



Group photo of the participants of the SMPT-2025

The Institute observed Swachhata Pakhwada from 16th February to 28th February 2025. Various events were organised as a part of this celebration, which were carried out by the Swachhata Committee members in close co-ordination with and active participation of all the staff members. The Pakhwada started with Swachhata Pledge taking ceremony followed by a Plog-a-thon within the campus on 17th February 2025. Other events like Essay competition, Best out of Waste Competition were organized during the fortnight, and Swachhata banners were displayed across all the three campuses to enhance awareness about the campaign. Tree plantation was carried out near the ST Plant behind the second security gate. DAE Joint Secretary - Finance graced the occasion with his presence, and saplings were planted by Swachhata Committee members as well as volunteers. Safai Sevaks (housekeeping and gardening staff) were served refreshment, as a token of appreciation for their continued efforts in maintaining clean and beautiful surroundings. A signature campaign and a sanitation drive was carried out at CPP-IPR Guwahati. The committee members and staff at CPP-IPR also carried out a Swachhata Walkathon.



Swachhata Pledge taking at IPR (L) and at FC IPT (R)



Swachhata Pledge taking at ITER-IN (L) and at CPP-IPR (R)



Photos of the Plog-a-thon at IPR



Participants of the Best out of Waste Competition

(L-R) Ms. Jyoti Agarwal, Ms. Harsha Macchar, Mr. Chirag Bhavsar, Ms. Priyanka Verma and Ms. Pratibha Gupta with their creations

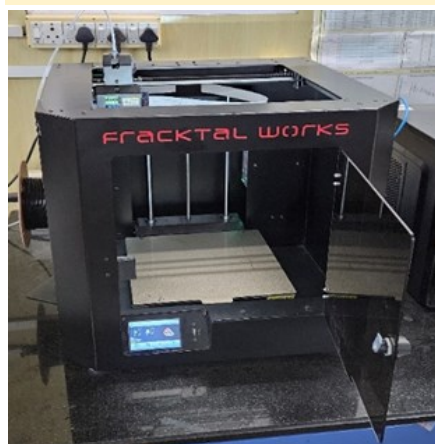


Tree Plantation at IPR by DAE Joint Secretary (Finance) and the Swachhata Team on 25 February 2025

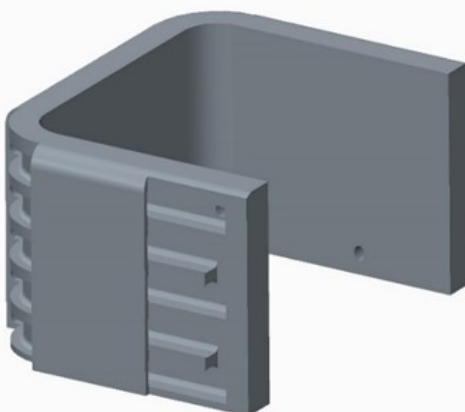
3D FDM printing facility prototyping of complex Fusion Blanket components

FDM (Fused Deposition Modeling) is one of the most popular and widely used 3D printing technologies. It is an Additive Manufacturing (AM) process where objects are built layer by layer using thermoplastic materials which include fabrication of intricate internal cooling channels in fusion blanket components and to optimize designs that are difficult/impractical to fabricate with traditional methods. A FDM printer with build size of 250 *x 250 x 300 mm (L*B*H) has been recently procured in Fusion Blanket Division for prototyping and feasibility check of AM to Blanket components and further transition to metal 3D printing technology for actual components. FDM printing involves designing a 3D model, slicing it for printing, preparing the printer and filament, then printing the model followed by post-processing steps like support removal and finishing.

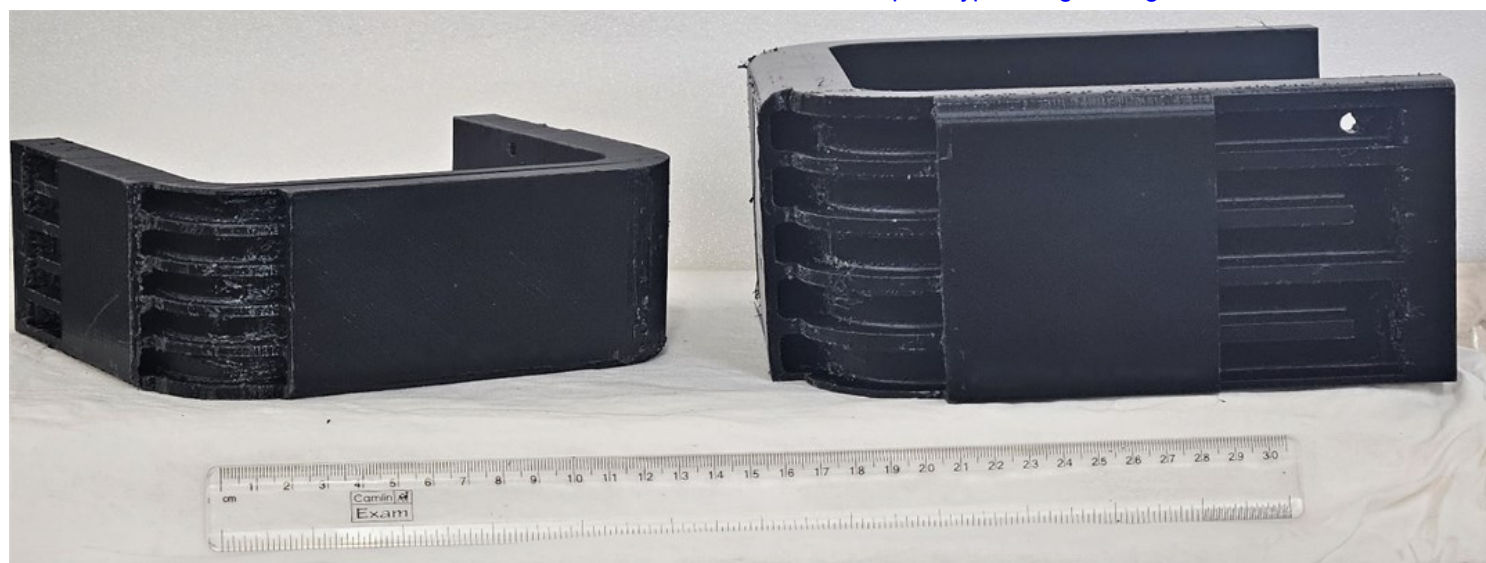
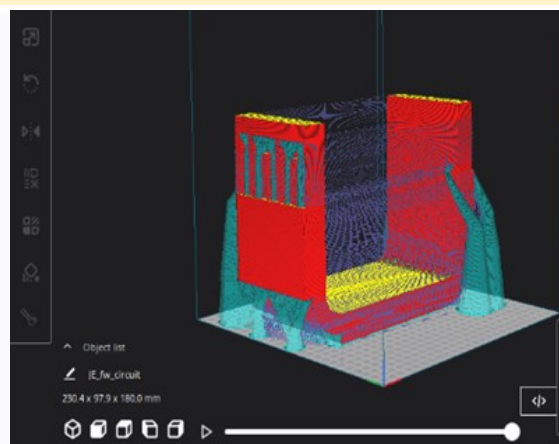
Some prototypes of Blanket First Wall (FW) with actual cooling channels have been fabricated with scaling of components to fit the machine parameters as shown in the figures below. Some of the prototypes for components related ceramic pebble manufacturing and characterization are also being made.



FDM Printer Machine



CAD model of FW prototype using Slicing Software



3D Printed FW (5 channels in one circuit) prototype models with internal channels

Mindstorming the Momentum

A mindstorming session was held on Sunday, 9 Feb 2025, to discuss the headway to the future planned projects, including the budgetary requirements. The Division and Section Heads attended the interactive session.



Dr D K Aswal, Director IPR leading the discussion with the senior staff members

Centre of Plasma Physics – Institute for Plasma Research (CPP-IPR) celebrated the National Science Day on 5th February, 2025 with day-long activities. To mark the occasion, several competitions like essay writing, drawing, quiz and extempore speech were organized for school students. Around 70 students and teachers from 8 schools visited the campus and participated in various events. Slogan writing competition was also organized for the CPP-IPR staff. Dr. Rakesh Moulick also gave a popular talk on plasma physics. Professor Deepali Sarkar, Head, Physics Department, Gauhati University was the chief guest of the event.



Glimpses of the National Science Day at CPP-IPR

CPP-IPR Outreach Programme at Bhattadev University, Assam

An outreach programme on the theme of “Plasma Science and Technology” was conducted by CPP-IPR’s Outreach Cell at Bhattadev University, Bajali, Assam on 19th February, 2025. The workshop was attended by 5 faculties and 112 students of the college. Dr. Rakesh Moulick and Dr. Ngangom Aomoa gave talks on plasma physics followed by live demonstration of glow discharge plasma, arc plasma, DBD plasma, Jacob’s ladder and a plasma globe.



Dr. Ngangom Aomoa (L) and Dr. Rakesh Moulick (R) giving their talks



Group Photo of the Students, Faculty and CPP-IPR Outreach cell at Bhattadev University, Assam

Academic Visits to CPP-IPR

Date	Institution	Visitors
21-February-2025	Department of Physics, Royal Global University, Guwahati, Assam	32 students of MSc and 2 faculty



Group photograph of students from Royal Global University, Guwahati, Assam

Conference Presentations

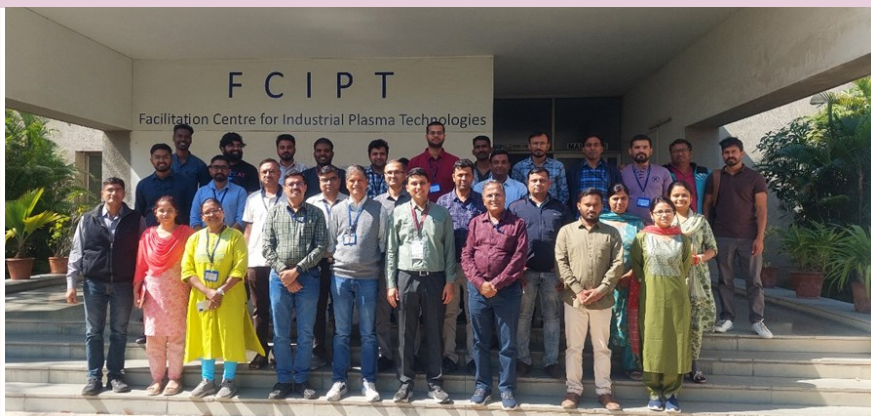
Dr. Mukesh Ranjan gave an invited talk in the International workshop on Cold Plasma Technology and Applications (CPTA-2025) at BIT MESHRA campus at Jaipur from 06-08 February 2025. Title of his talk was “**Ar plasma Nanostructuring on PTFE surfaces for the self-cleaning and sensing application in Food, Agriculture and Medical Science**”



Dr. Mukesh Ranjan giving his talk and receiving appreciation during the Conference

Talk on Corporate Social Responsibility (CSR) funds

A talk on “**Advancing R&D through Corporate Social Responsibility (CSR)**” by **Mr. Manuj Tripathi** (Principal Scientist at CSIR-IMTECH), was organized in FCIPT on 05 Feb 2025. Talk was focused on the underutilization of CSR funds in India's Research & Development (R&D) ecosystem. The talk enhanced the knowledge of CSR landscape in context of R&D, CSR project proposals, funding cycle, and carve out a path to learn from some of the best practices across the organizations.



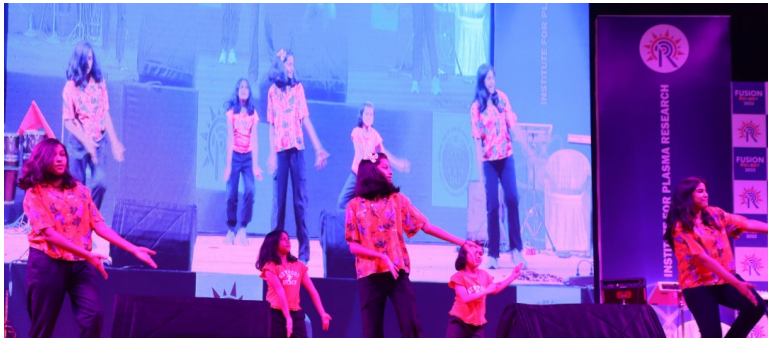
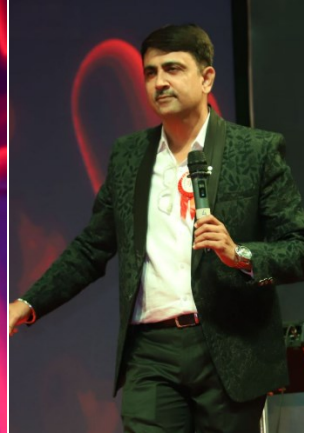
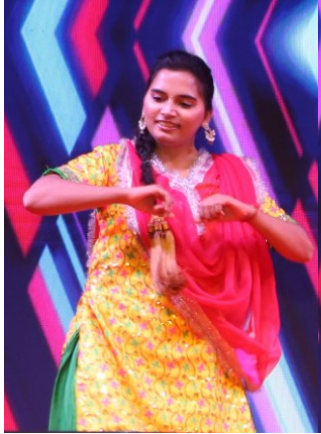
The 34th IPR Annual Day, Fusion Fiesta 2025 was celebrated on 01 Feb 2025. The much awaited annual event was organized after a gap of 5 years. The staff and their families participated with full excitement and enthusiasm. More than 1200 people attended the celebration. The event was inaugurated by Deans (Admin, Academic and R&D), the ITER-IN Project Director, CAO and the Staff Club President.

The vibrant evening extravaganza included various cultural programs such as Dance, Drama, musical performances by the IPR staff and their families and finally, the much awaited Garba, the traditional folk dance of Gujarat. The guests enjoyed scrumptious food. The pictures in following pages will give you a glimpse of the vibrancy and enjoyment of the event.



Glimpses of the Inaugural ceremony of the 34th Annual Day





- ♦ **Mr. Aroh Shrivastava**, gave a talk on "Pebble Bed Thermal Expansion and Sintering Investigation of Lithium Titanate for Fusion Blanket Application" at 24th DAE-BRNS Symposium On Thermal Analysis (THERMANS-2024), Bhabha Atomic Research Centre, Mumbai, 16-18 January 2025
- ♦ **Dr. K M Rakhi**, Indian Institute of Technology Ropar, Punjab, gave a talk on "Dynamical Evolution of Self-organized Nanostructures Produced by Unconventional Ion Beam Irradiation Techniques" on 27th January 2025
- ♦ **Mr. Uday Kumar**, gave a talk on "A Step Towards Eco-friendly Electropolishing of SS304L Stainless Steel for Nuclear Fusion Applications" at International Conference on Energy Conversion and Storage (IECS 2025), Indian Institute of Technology Madras, Chennai, 27-29 January 2025
- ♦ **Dr. Raj Singh**, gave a talk on "Determination and Matching of Antenna-Plasma Coupling Impedance for Ion Cyclotron Range of Frequencies and Its Uses for Plasma Applications" on 29th January 2025
- ♦ **Mr. Mayur Mehta**, gave a talk on "Study of neutron induced reactions of different materials for reactor applications" on 04th February 2025
- ♦ **Ms. Gayatri Barsagade**, gave a talk on "Quasi-longitudinal whistler mode activity in magnetized plasma" on 07th February 2025
- ♦ **Dr. Mamta**, gave a talk on "Intense laser interaction with an inhomogeneous plasma: Validation of electromagnetic fields at oblique incidence and different polarization" on 11th February 2025
- ♦ **Dr. Sarvesh Kashyap**, gave a talk on "Design and Development of closed-loop pulse tube refrigeration (PTR) system for a Cryopump" on 19th February 2025
- ♦ **Prof. U. A. Yajnik**, Indian Institute of Technology, Gandhinagar, gave a talk on "Cosmic conundrums and their Particle Physics solutions" on 20th February 2025 (**Colloquium #341**)
- ♦ **Dr. Ipsita Chinya**, CSIR-Central Glass and Ceramic Research Institute (CSIR-CGCRI), Kolkata, gave a talk on "Development of Polymer Nanocomposites as Self-powered Sensors, Optoelectronics, and Flexible Energy Harvester and Storage" on 21st February 2025
- ♦ **Dr. Amit K Bhojani**, Institute of Infrastructure Technology Research and Management (IITRAM), Ahmedabad, gave a talk on "Advancing Energy Materials through Computational and Experimental Synergy" on 28th February 2025

Upcoming Events

- ♦ Joint March Meeting and April Meeting: Global Physics Summit 2025, Anaheim, California, 16–21 March 2025; <https://www.aps.org/events/2025/joint-meeting>
- ♦ 18th Technical Meeting on Energetic Particles in Magnetic Confinement Systems, University of Seville, Spain, 17-21 March 2025; <https://indico.iter.org/event/484/>
- ♦ 3rd International Conference on Advances in Science, Engineering & Technology (ICASET-2025), Chennai, 22-23 March 2025; <https://www.icaset.in/>
- ♦ 24th National Symposium on Radiation Physics (NSRP-24), DAE Convention Centre, Mumbai, 27-29 March 2025;

Congratulations!!

Ms. Geethika B R, Research Scholar, gave a talk on "**Characteristics of Polarized Emission from Laser Produced Plasma**" at **24th National Conference on Atomic and Molecular Physics (NCAMP 2025)**, Indian Institute of Technology Dhanbad, 08-11 January 2025.

She received **Best Poster Award** for her presentation.

Many Congratulations to her for this achievement!



The IPR Staff Club recently organized the IPR Cricket Championship tournament, the Plasma Trophy 2025.

There were 11 participating teams, involving more than 170 staff members of IPR, ITER-India & FCIPT, playing in a total of 58 matches. The high-intensity 21-over final match was played on 23 February 2025 between Motera Indians and Fusion Warrior. In the final clash of two Titans, Motera Indians batting first made a huge total of 198 runs by losing 5 wickets. In response, Fusion Warrior though started well, got all out for 115 runs in 16.5 overs. It was a dominating performance by Motera Indians.

The final match was a true test of endurance, skill, and strategy of both the teams. The ability to maintain the composure and execute the game plan was the deciding factor which set the teams apart as the deserving winners of the prestigious tournament.

Congratulations to Team **Motera Indians** for winning the Plasma Trophy 2024-25 and the team **Fusion Warrior** for their impressive performance as the runner-up team.

Congratulations to all the teams for participating the in the tournament and playing in the true sportsmanship spirit.

We would also like to congratulate all the prize winners for their achievements in the tournament.



Devesh Saini (L) of MI was awarded the Best Batsman of the Tournament. He had an exceptional tournament (Scored 575 runs with an average of 95.8 and Strike rate of 210, 100s - 1, 50s – 05, Wickets – 08)

Sudhir Rai (R) of MI was awarded the Best Bowler of the Tournament for his outstanding performance throughout the series. He took 18 wickets with an average of 10.7



The Winners – Motera Indians team (Standing L-R) Rajan Kumar, Sudhir Rai, Devesh Saini, Vishal Verma, Shashank Singh, Shailendra Trivedi, Rakesh Patel, Rahul Kumar Raj, Jasraj Dhongde, Mahesh Ghate, G. K. Rajan. (Sitting L-R): Nitin Bairagi, Jignesh Patel, Akhilesh Singh (C), Harish Masand

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Know Your Colleague



Mr. Rajnikant Pragjibhai Bhatasana completed his Diploma in Mechanical Engineering from Lakhadheerji Engineering College, Morbi, in the year 2004. He joined IPR in the year 2015 in the Large Cryogenic Plant and Cryosystem (LCPC) Division as Scientific Assistant-B. Initially he was deputed at LCPC lab of IPR at Vidhata campus where he contributed the setting up of the laboratory from scratch. Presently, he is working as Scientific Assistant-C. He has supervised the installation, performance tests and acceptance of air compressors. He was involved in the work of conversion of air compressor into Helium compressor. He carried out the leak testing in the high vacuum system by Mass Spectrometer Leak Detector (MSLD) and other techniques. He has been actively participating in various Hindi competitions organized by IPR and also won several prizes. He is also actively involved in the Hindi translation work. He is a part of staff club committee over past three years and has contributed in organizing various events of staff club. He was awarded "Outstanding Staff Member of the Year 2019 (OSMY)" for his dedicated work of conversion of air compressor into Helium compressor.

AEC Chairman visits FCIPT



Quote of the Month

"If everyone is moving forward together, then success takes care of itself."

--Henry Ford

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