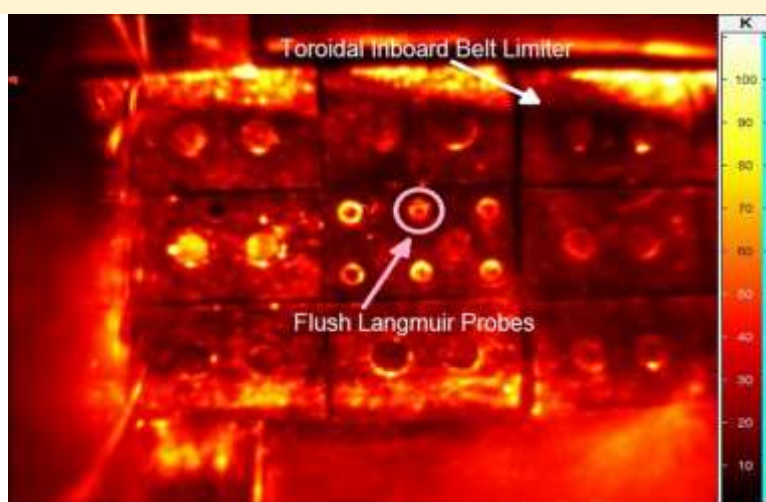


The Fourth State

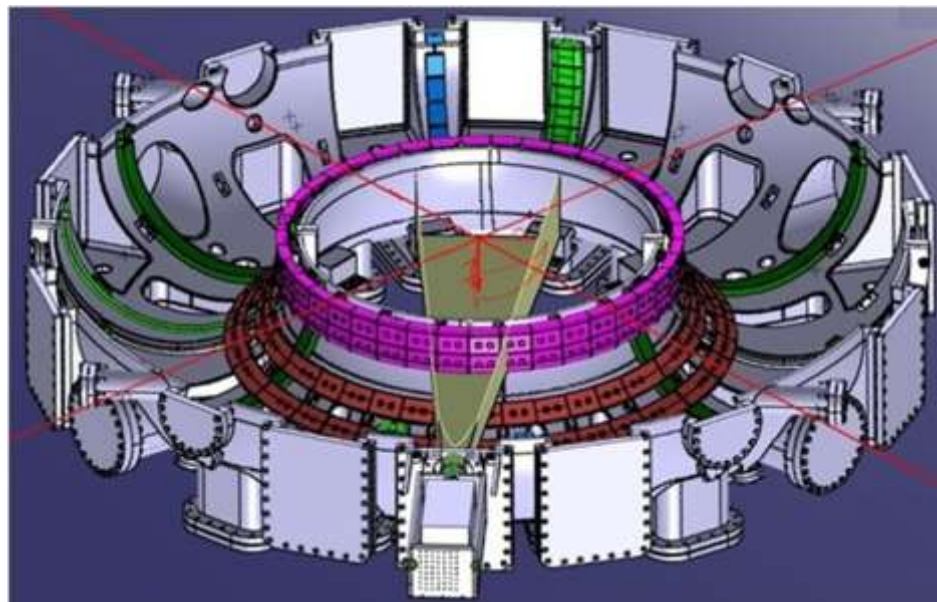
Newsletter of the Institute For Plasma Research, Gandhinagar, Gujarat (India)

Thermal Imaging And Flush Langmuir Probe Diagnostic For Aditya-U

Thermal imaging diagnostic is an important tool to study the interaction of plasma with the first wall surfaces made of graphite called the Plasma Facing Components (PFCs). Heat flux drawn by the PFCs due to the plasma wall interacting is estimated by real-time measurement of the temperature of these graphite components. Infrared (IR) camera is used to map the temperature distribution on these PFCs. Limiter is a PFC which shapes and limits the extent of the plasma inside the tokamak. Figure 1 shows the installation of the toroidal inboard belt limiter inside the Aditya-U vessel. These graphite tiles on the limiter belt are imaged by IR imaging camera for measuring its temperature rise due to the plasma wall interaction. These thermal images will be post processed for evaluation of heat flux. Langmuir probes are used extensively to characterize the low temperature plasmas. Probes can measure temperature, density and plasma potential. This information measured in the proximity of the PFCs can alternatively yield the heat flux. Validation of the heat flux estimated by the IR imaging diagnostic is possible using the Langmuir probe measurements. Flush mounted Langmuir probe diagnostic was conceptualized, designed, fabricated and installed on the Aditya-U tokamak. The probes are installed in the field of view of the IR camera and hence can be seen in the thermal image. This guarantees a better correlation between the heat fluxes measured independently by both these diagnostics. *Contributor : Shwetang N. Pandya*



(L) The toroidal inboard belt limiter installed inside the Aditya-U tokamak showing the installed six flush mounted Langmuir probes on a graphite tile (R) Thermal image of the same toroidal inboard belt limiter during the plasma disruption in a typical Aditya-U discharge # 31201.



Baking of the vessel and PFCs is carried out to remove the adsorbed impurities. Aditya-U is equipped with baking capabilities. The Aditya-U vessel was baked at 135 °C. The limiter and vessel wall temperatures were monitored using the IR camera to check its uniformity and steady state temperature. This ensures that the temperature uniformity throughout the vessel is achieved and maintained. The temperature monitoring was carried out continuously for more than 48 hours.

CAD 3D drawing showing the half cut Aditya-U machine along with the thermal imaging diagnostic installation. The IR camera installed inside the soft iron shield box is viewing the inboard limiter as shown by the field of view.

The first NFP-PFRC Vision Meeting was jointly organized by the Institute for Plasma Research, Gandhinagar and Nirma University, Ahmedabad during 26-28 April 2018. Over 150 participants, mainly consisting of PI's, PC's, experts and prospective PI's attended this meeting. The meeting was also attended by the current and past PFRC committee members.

This meeting was conceptualized by the PFRC Committee to take stock of the work carried out under the aegis of erstwhile BRFST earlier and since 2014, under the Plasma and Fusion Research Committee of the BRNS during the last 10 years. This meeting also had detailed deliberations to charter the plans for future areas of R&D in the coming decade.

Prof. P I John, Chairman PFRC in his keynote address entitled "*The National Fusion Programme: Retrospect, Prospect*", gave a brief account of the 10 years of NFP, BRFST and formation of PFRC. He described how PFRC has been able to bring together faculty from various institutions in India who had no prior experience in R&D related to plasma or fusion to successfully work on a fusion related topic. There were two plenary talks on "*Tokamak Research in India and Its Future*" by Dr. R. Srinivasan and "*Societal Benefits of Plasma Technologies – Alignment of Future R&D towards DAE 11-Point Vision*" by Dr. S Mukherji respectively. This was followed by 16 invited talks by PC's who consolidated the various projects in a specific area as well as gave their views on possible new areas of R&D possible in those areas. The Scientific Secretary of BRNS, Prof Sangita gave a talk on BRNS, its activities and funding procedures for the benefit of the participants and prospective PI's. PI's also presented over 75 posters based on the work carried out under various BRFST and PFRC funded projects. A book of abstracts was also released during the meeting. It is proposed that selected papers presented during the meeting would be peer reviewed and published as a special issue in a journal.

Two panel discussions were organized to discuss various issues related to carrying out R&D projects and also to discuss future areas of work. It was proposed to initiate NFP-PFRC working groups under 12 different areas where most of the R&D under PFRC were focused on.



(L) Inauguration of the meeting (R) Releasing the book of abstracts



(L-R) Prof. Sangita, Dr. Chenna Reddy, Prof. A. K. Ray, Prof. Amit Roy and Prof. Prabal Chattopadhyay addressing the audience



(L-R) Prof. P I John delivering the Keynote Address, Prof. R Srinivasan and Prof. S Mukherjee delivering Plenary Talks.



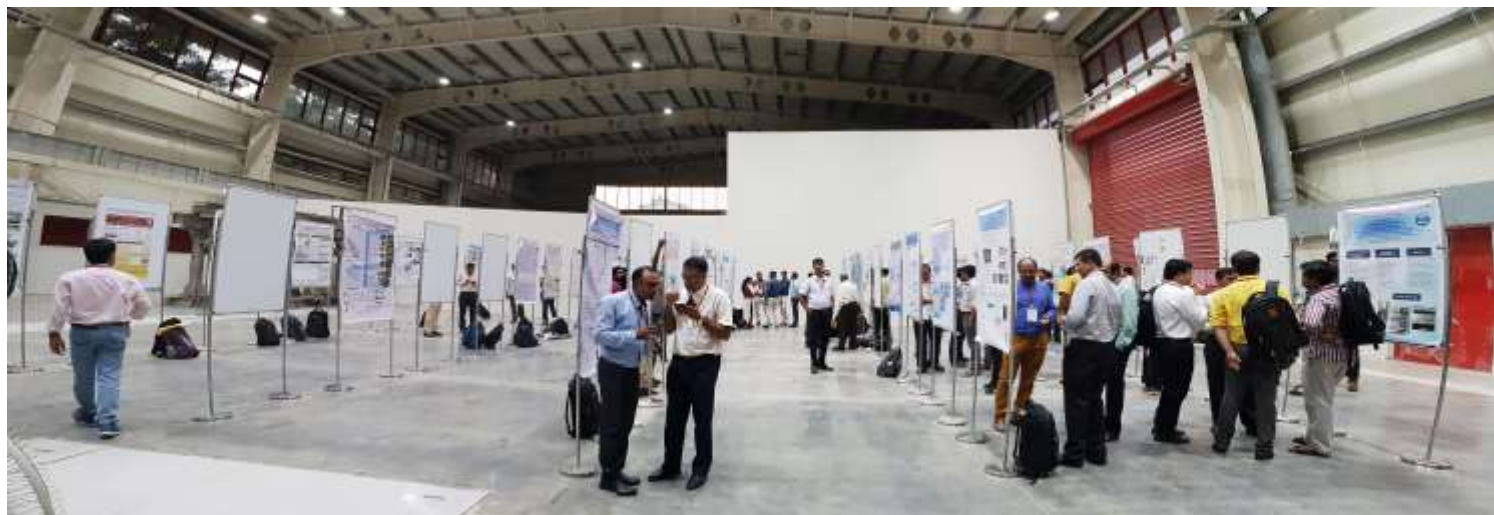
The two panel discussion sessions in progress



(L-R) Saroja S (IGCAR), S. S, Khirwadkar. Ranjana G, A. K. Sahu, P. Bhandyopadhyay, R Ganesh and S. K. Pathak delivering their invited talks



(L-R) M.B. Chowdhury, D. Raju, S. K. Nema, K. K. Gotewal, P. V. Subhash, H. Dave and N. Ramasubramanian delivering their invited talks



The poster session in progress at IPR



The participants of NPVM-2018

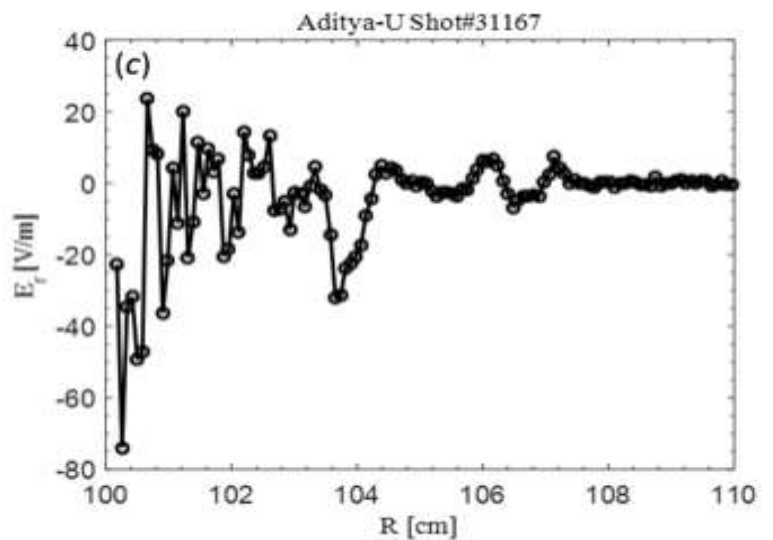
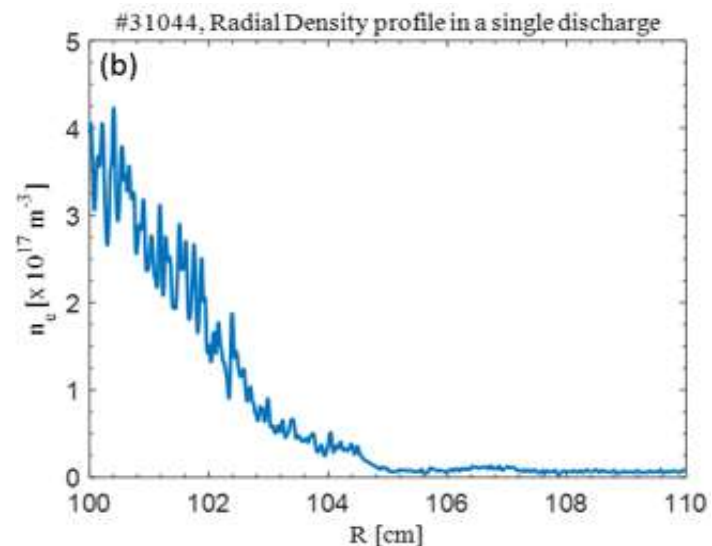
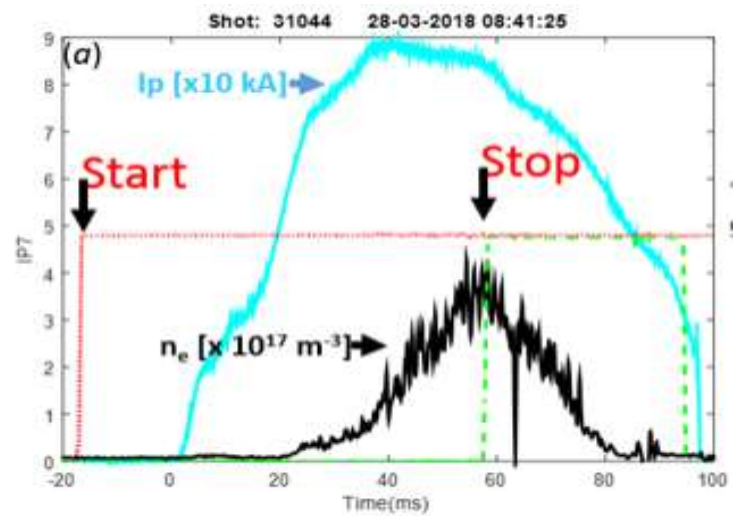
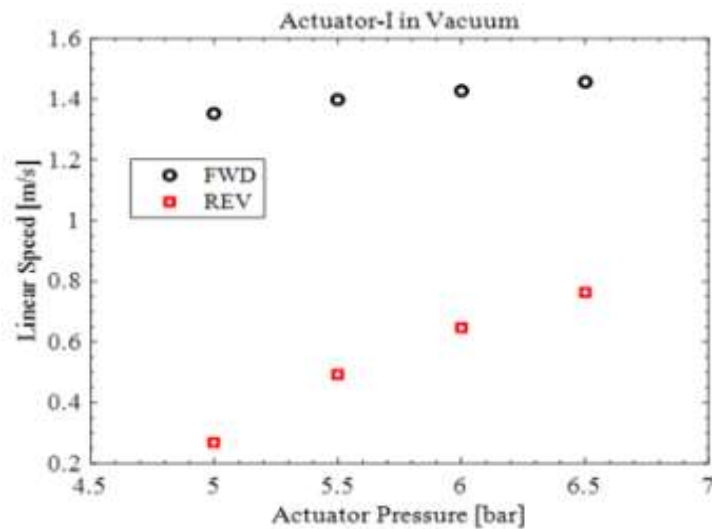
Fast Actuating SOL Probe (FASP) In Aditya-U

Plasma density and temperature profiles near ICRH antenna determines not only antenna load impedance, but also affects the way the correct choice of wave couples to the plasma. ICRF power also modifies these SOL profiles and measurements of these parameters can be useful to study transport, flow drive and effect of sheath rectification on impurity generation due to ICRH operation. Rectified RF field also tends to modify edge electric field profile and may have an impact on turbulence suppression and rotation induced suppression of island growth. To study these effects, local measurements during ICRF operation is highly desirable. Measurement of profiles traditionally being done with shot to shot basis is cumbersome and introduce large errors due to varied plasma conditions. To alleviate these concerns, a simple pneumatic actuation based diagnostics is developed by modifying a sample transfer feedthrough to actuate a set of miniature Langmuir probes to scan the SOL during plasma current (I_p) flattop. The actuator movement is controlled by a pneumatic cylinder and air pressure is timed by a fast response solenoid valve (35ms response time to open with ± 1 ms repeatability). The USP of this diagnostics is that it is simple to construct, cheap ($< ₹80K$) compared to complex reciprocating probe and is easy to operate. This diagnostic can be used to measure plasma spatial variation within a short time in tokamak as well as in basic plasma devices.

Contributor : Kishore Mishra



Assembled actuator with the Langmuir probes



Clockwise (from Top left) Speed result in vacuum chamber with different inlet pressure (a) A typical plasma discharge with I_p and measured n_e , shows the probe movement from $R110$ cm (start) to $R100$ cm (stop) scanning 10cm in 76ms i.e. the 2cm SOL region in < 20 ms. Preliminary measured n_e and E_r in a not so large flattop discharge are shown in Fig b, c.

The 2nd training programme in the joint IPR-NCSTC scientific outreach series “Awareness-Cum-Training Programme On Plasma Science & Technology and Energy from Nuclear Fusion” funded by the National Council for Science and Technology Communication (NCSTC), DST, New Delhi for S&T popularization centered around the applications of plasma science and technology and energy from nuclear fusion was conducted at Bhopal during 7-8 May, 2018. The programme was locally organized by the Madhya Pradesh State Council for Science & Technology. 49 Physics teachers of high/senior school and junior colleges from the states of Madhya Pradesh, Uttar Pradesh, Bihar, Chhattisgarh and Jharkhand attended this training programme. The meeting was held at the Vigyan Bhawan, at the MPCST complex at Nehru Nagar Bhopal. Inauguration of the programme was carried out by the Director General of MPCST, Dr. Navin Chandra. Dr. Rakesh K Arya Chief Scientist and Dr. S. K. Garg, Senior Technical Officer in-charge of Popularization of Science, from MPCST along with Dr. N. Ramasubramanian and Dr. Ravi A V Kumar from IPR presided over the meeting.

The Programme has popular talks, hands on plasma experiments and interactive sessions with the trainers. Books on plasma, posters as well as a science activity kit and DVD with resource materials were provided to the participants. The IPR team consisted of N Ramasubramanian, Chhaya Chavda, Harsha Machchhar, K K Mohandas and Ravi A V Kumar.



(L) Inauguration of the programme by Dr. Navin Chandra (R) Demonstration of the activity kit in progress



Training programme in progress



Participants of the IPR-NCSTC training programme held at Bhopal



Setting up of the hands-on training programme for the participants



Hands-on training programme in progress

Atmospheric Plasma Division (APD)

Atmospheric Plasma Division (APD) at FCIPT, is involved in exploitation of atmospheric pressure plasmas for the development of environment friendly process and technologies for different applications to benefit industries and society at large. This division focuses on ;

- Plasma Pyrolysis/Gasification activities, currently working on to establish an advanced biomedical waste treatment facility that includes 200 kg/hr plasma pyrolysis system for safe disposal of biomedical waste.
- Textile treatment activities, at present developing a facility of high speed ~ 40meter per minute to treat 2.5 meter wide fabric using dielectric barrier discharge plasma in air sponsored by Department of Science and Technology.
- Nano powder activities, involved in formation of metals and their oxides useful for different applications.
- Development of high power plasma torches for various high heat flux applications.
- Development of sterilization system for biomedical devices.
- Plasma activated water for agricultural applications by providing environment friendly chemical in place of pesticide,
- Plasma Jets for denim fading & patterning and surface activation and sterilization of polymers & textiles etc.



The members of the Atmospheric Plasma Division at FCIPT.

From left to right: **1st row:** Subrat Das, Vishal Jain, Nisha Chandwani, Purvi Kikani Dave,

2nd row: Kushagra Nigam, C. Balasubramanian, Sudhir K Nema (Division Head), Adam Sanghariyat, G Ravi ,

3rd row: P. Vadivel Murugan, Chirayu Patil, Bhupendra Patel, Nimish Sanchaniya

Inertial Electrostatic Confinement Fusion (IECF) devices have been developed at CPP-IPR. A cylindrical IECF device is currently under operation. At present, the device (India's maiden inertial electrostatic confinement fusion device) is being operated at 80 kV for a few minutes and it produces 10^6 neutrons per second. Meanwhile another IECF device (spherical configuration) has been installed and deuterium plasma is being produced by making use of cold cathode discharge. Further characterization is in progress. The purpose of developing cylindrical and spherical IECF devices is for constructing anisotropic and isotropic DD neutron sources for many near-term applications such as fusion material testing and explosive detection.



The IECF Laboratory at CPP-IPR with Spherical and Cylindrical IECF devices, Members (L to R) Mr. D. Jigdong, Mr. D. Bhattacharjee, Mr. M. K. D. Sarma, Mr. S. Kalita, Dr. S.R. Mohanty

IPR Visits

Date of Visit	Institution	Course undertaken by the visiting students	Number of visitors
04-May-2018	Indus University, Ahmedabad	Metallurgical Engineering	Students : 39 Faculty : 02
18-May-2018	Ahmedabad Management Association, Ahmedabad	Management / Innovation	Trainees : 20 Faculty : 01
18-May-2018	Gujarat Science Academy, Ahmedabad	Physics	Students : 34 Faculty : 01

Past Events @ IPR

- ◆ **Mr. Gaurav Kumar Singh**, Institute for Plasma Research, Gandhinagar, gave a talk on "*Study of two phase flows in fusion magnets*" on 26th April 2018
- ◆ **Mr. Sunil Bassi**, Institute for Plasma Research, Gandhinagar, gave a talk on "*Numerical Simulations of Deflagration to Detonation Transition (DDT) process in Pulse Detonation Engine*" on 27th April 2018
- ◆ **Dr. S. Sangeetha**, Bharathiar University, Coimbatore, gave a talk on "*A Study on Teletherapy Dosimetry using Monte Carlo Code*" on 27th April 2018
- ◆ **Mr. Shivam Kumar Gupta**, Institute for Plasma Research, Gandhinagar, gave a talk on "*Development of Control Algorithm for Co-operative Aerial Survey using Swarm UAVs*" on 4th May 2018
- ◆ **Mr. Jervis Ritesh Mendonca**, Institute for Plasma Research, Gandhinagar, gave a talk on "*Flow Effects on Visco-resistive modes in a Tokamak*" on 14th May 2018
- ◆ **Mr. Subrata Jana**, Institute for Plasma Research, Gandhinagar, gave a talk on "*Study on Plasma Shaping and Control in Steady State Superconducting Tokamak (SST-1)*" on 16th May 2018
- ◆ **Mr. Arun Pandey**, Institute for Plasma Research, Gandhinagar, gave a talk on "*Development of a permanent magnet based helicon plasma source*" on 21st May 2018

18 मई, 2018 को 'वैज्ञानिक संस्थानों में राजभाषा का प्रयोग' विषय पर हिंदी कार्यशाला आयोजित की गई, जिसमें अधिकारियों को प्रशिक्षण देने हेतु श्रीमती नीलू सेठ, वरिष्ठ हिंदी अधिकारी, अंतरिक्ष उपयोग केन्द्र, अहमदाबाद को आमंत्रित किया गया। कार्यशाला के प्रारंभ में राजभाषा कार्यान्वयन समिति के उपाध्यक्ष श्री राज सिंह ने तकनीकी वर्ग द्वारा सरलता से हिंदी का सहज प्रयोग करने पर चर्चा की। उन्होंने इस बात पर जोर दिया कि हिंदी भाषा की अभिव्यक्ति में सहज शब्दों का प्रयोग होने पर ही वह अभिव्यक्ति सरल बनेगी। इसके लिए आवश्यक है कि तकनीकी हिंदी लेखन में यदि प्रचलित अंग्रेजी शब्द अनायास ही समावेश हो रहे हों तो उन शब्दों को अपना लेना चाहिए। इससे लिखने का प्रवाह बना रहता है। जबकि किसी अंग्रेजी शब्द का उसी समय हिंदी अनुवाद ढूंढने जाएं तो कदाचित्त वह प्रवाह नहीं रहेगा। श्री राज सिंह ने ये महत्वपूर्ण सुझाव देते हुए कर्मचारियों को तकनीकी लेख लिखने के लिए प्रेरित किया।

श्रीमती नीलू सेठ ने राजभाषा संबंधी नीति के प्रमुख बिंदुओं पर विस्तार चर्चा की और राजभाषा के कार्यान्वयन में आ रही प्रमुख समस्याओं का भी उल्लेख किया और उसका समाधान भी प्रस्तुत किया। उन्होंने सभा कक्ष में उपस्थित अधिकारियों द्वारा हिंदी के प्रयोग में आ रही कठिनाईयों से संबंधित संदेह भी दूर किये और हिंदी की उत्तरोत्तर प्रगति के लिए भाषा के प्रति आदर का भाव रखते हुए अपनी इच्छा शक्ति को जागृत कर आगे बढ़ने के लिए प्रेरित किया।



हिंदी कार्यशाला की कुछ तस्वीरें

Infrastructure - Neutronics Building



The work of the neutronics building is nearing completion. All RCC work has been completed and de-shuttering of the neutron generator hall is currently underway. Internal vitrified tile flooring, plumbing and electrical works are in progress. On the external side, stone cladding work is under progress.

- ◆ INS National Workshop on Pressure Vessels Design and Fabrication, Indian Nuclear Society, Project Square, Anushaktinagar, Mumbai, 18-22 June 2018. <http://indiannuclearsociety.in/>
- ◆ 45th EPS Conference on Plasma Physics, Prague, Czech Republic, 2-6 July 2018. <https://eps2018.eli-beams.eu/en/>
- ◆ 50th Conference of the European Group on Atomic Systems (EGAS), Krakow, Poland, 9-13 July 2018. <https://egas50.org/>
- ◆ 12th International Conference on Advances in Fluid Mechanics, Ljubljana, Slovenia, 10-12 July 2018 <http://www.wessex.ac.uk/conferences/2018/afm-2018>
- ◆ 18th International Balkan Workshop on Applied Physics and Materials Science (IBWAP 2018), Constanta, Romania, 10-13 July 2018 <http://ibwap.ro/>
- ◆ Europhysics Conference on the Atomic and Molecular Physics of Ionized Gases (ESCAMPIG XXIV), Glasgow, United Kingdom, 17-21 July 2018 <https://www.gla.ac.uk/schools/physics/research/groups/astro2/escampig/>
- ◆ COSPAR 2018, Pasadena, California, USA, 14-22 July 2018. <http://cospar2018.org/>
- ◆ International Conference on Advanced Nanomaterials (ANM2018), Aveiro, Portugal, 18-20 July 2018 <http://www.advanced-nanomaterials-conference.com/>
- ◆ 26th International Conference on Nuclear Engineering (ICONE-26), United Kingdom, 22-28 July 2018 <https://www.asme.org/events/icone>
- ◆ 7th International Conference on Microelectronics and Plasma Technology (ICMAP 2018), Incheon, Korea, 25-28 July 2018. <http://www.icmap-2018.org/>

Know Our Colleagues



Mr. Dharmendra Rathi joined the Institute in 2000 in the RF Division/ ICRH group and continues to work in the ICRH Division as Scientific Officer. He was actively involved in fabrication, installation, and commissioning of the SST1 ICRH system. He has contributed for the development of antenna system, Vacuum Tx-line (VTL) and Tx-line & Matching (TL & MS) system. In 2009, he was deputed to ITER Organization as ICH&CD system Technical Officer for the design & development of 20 MW Antenna and TL & MS system. Later, he was technically promoted as Technical Responsible Officer (TRO) for TL & MS procurement with USDA in addition to antenna development task with EUDA. He was also responsible for ICH vacuum system, remote handling, CAD model design management, layout and interface management. On his return in 2014, he resumed his work for SST1 ICRH and Aditya-U ICRH upgrade with an additional joint task of developing India's First Indigenous High Power Gyrotron system (42 GHz, 200 kW). He has contributed for the Gyrotron vacuum leaks remedy, baking & UHV testing, cooling system, microwave characterization, cavity Cu magnet system, assembly and installation, HV conditioning & operations and high power microwave testing.

Mrs. Pratibha Semwal joined the Institute in 2000 in the SST-1 Vacuum Group. She was involved in the procurement, testing and installation of different vacuum components and sub-systems during the commissioning phase of the SST-1 machine. She was awarded the Outstanding Staff Member of the Year award in 2003. Apart from the involvement in various group activities, she has developed a high-vacuum gauge calibration system which is at present in use for the testing and calibration of various vacuum gauges used in different divisions of IPR. She has also worked on the layout, testing and validation of the SST-1 gas feed system. She completed Erasmus Mundus Masters in Nuclear Fusion Science and Engineering Physics from Ghent University, Belgium in 2011 and submitted a master thesis on the detection of fine structure blobs in the TJ-II stellarator using intensified visible fast cameras. Presently she is an active member of the Vacuum Engineering and Services Division (VESD) and involved in various activities taken up by this division.



The IPR Newsletter Team

Ritesh Srivastava	Tejas Parekh	Ravi A. V. Kumar	Priyanka Patel	Dharmesh P	Mohandas K.K.
Suryakant Gupta	Ramasubramanian N.	Chhaya Chavda	Shravan Kumar	Supriya Nair	Harsha Machchhar

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