

Issue 092
March 2021

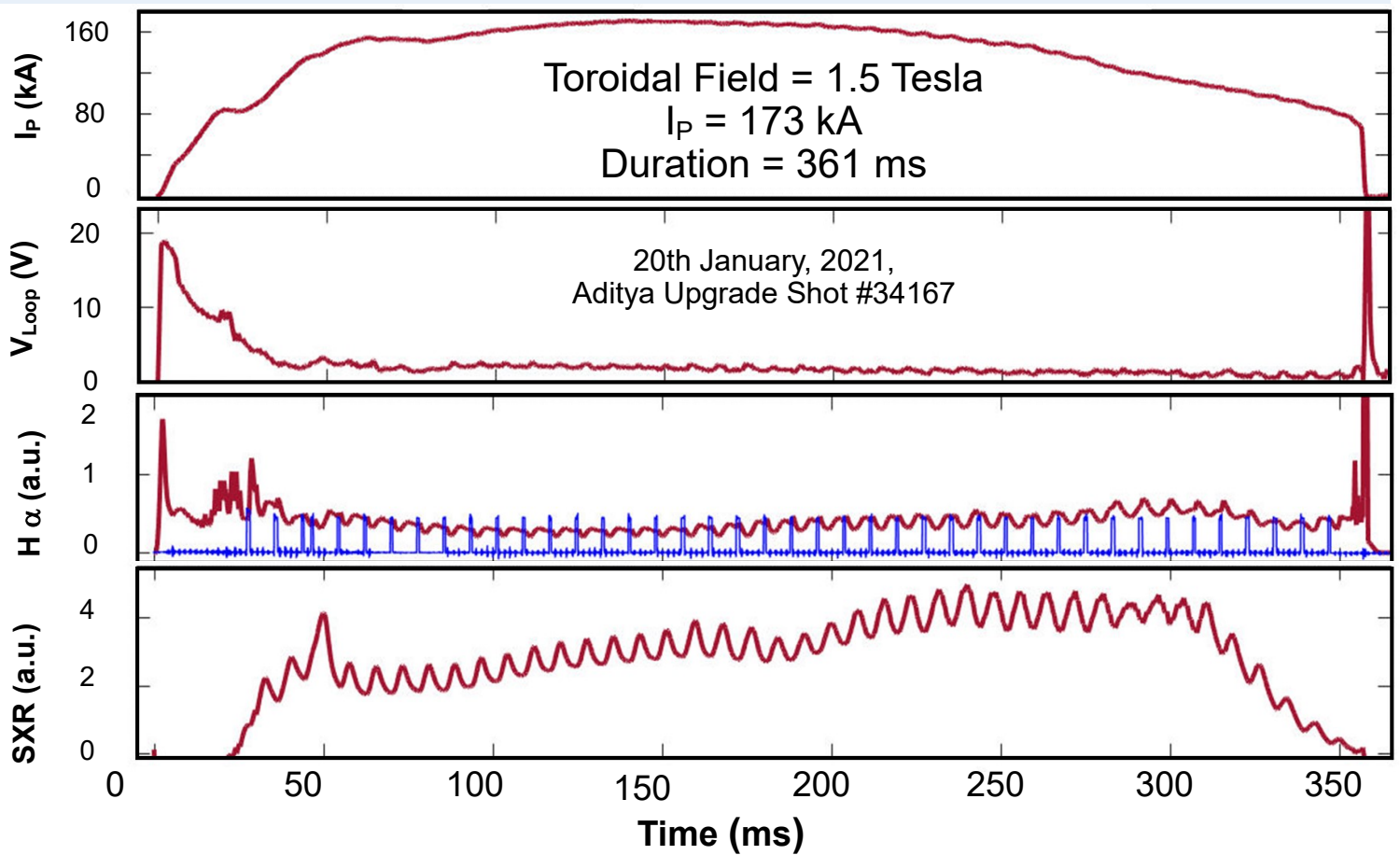
The Fourth State

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

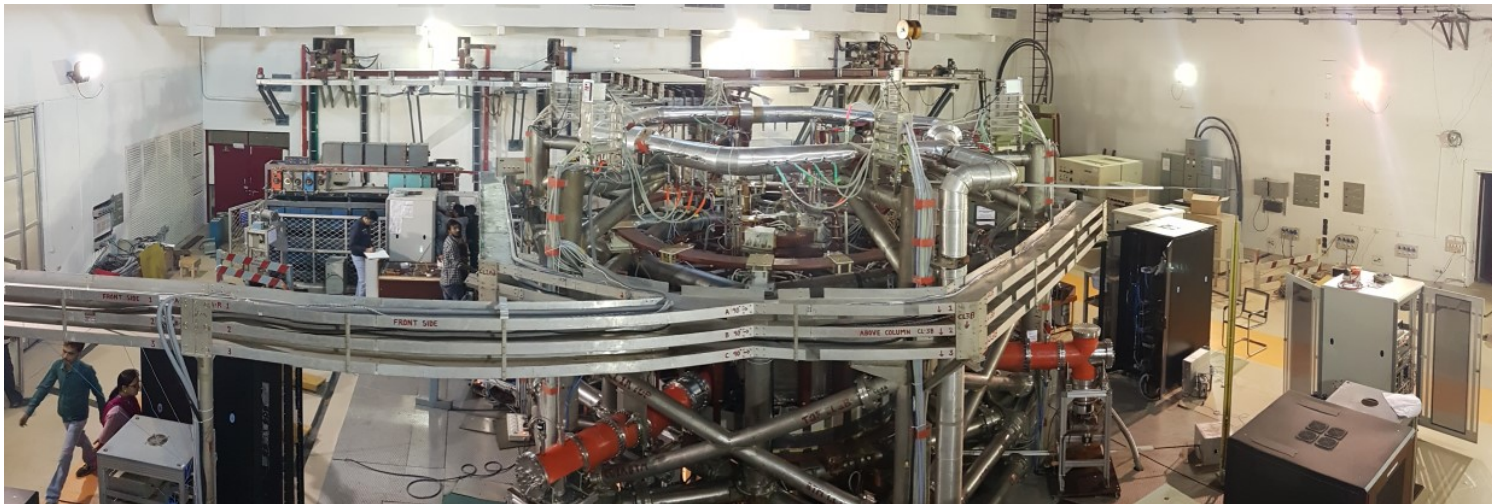


Aditya - U : Update

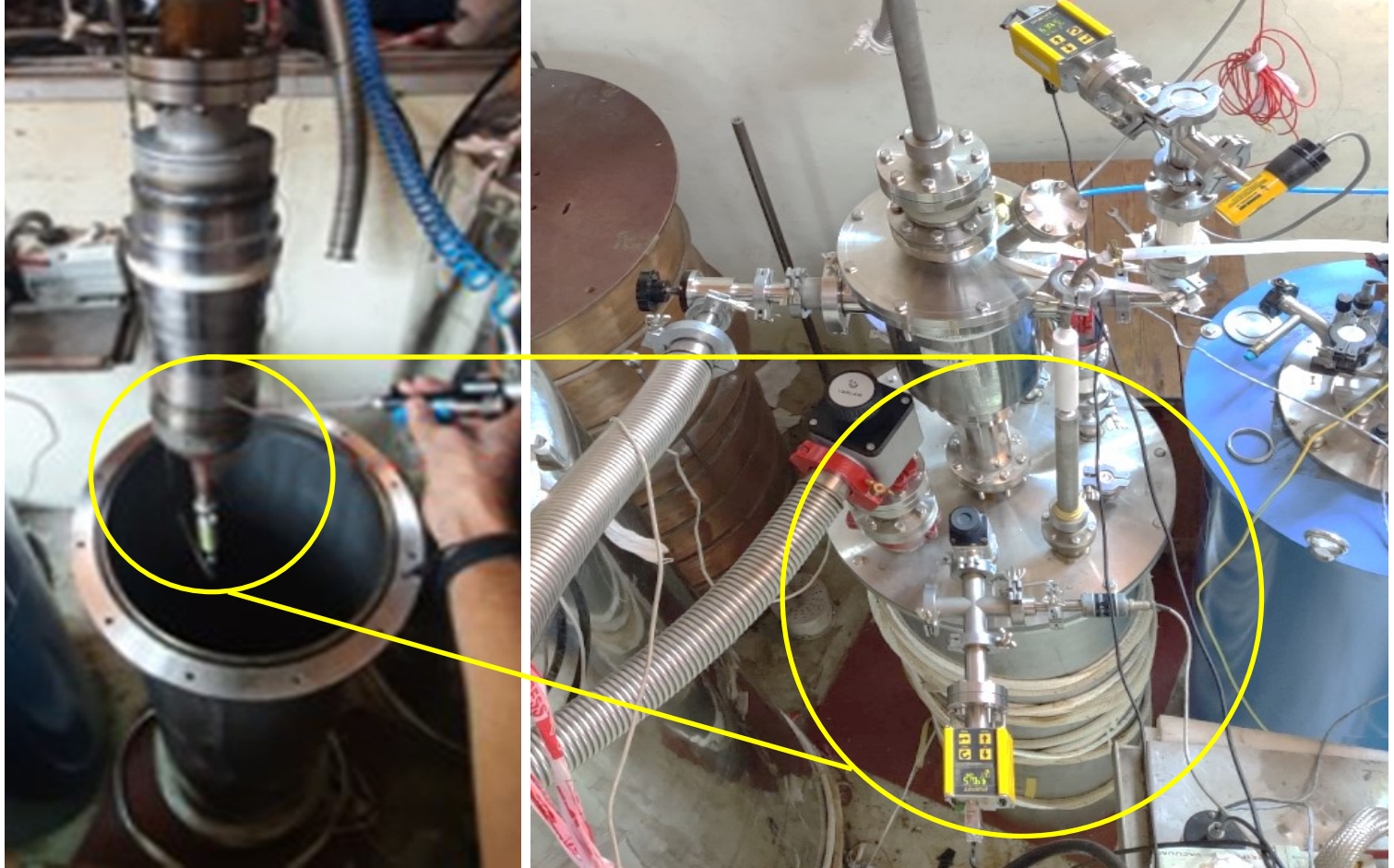
The ADITYA-U tokamak has been operated at the full design value of 1.5 Tesla for the main (toroidal) magnetic field, combined with a long plasma duration of 360 milliseconds, which is 20% higher than its original design value.



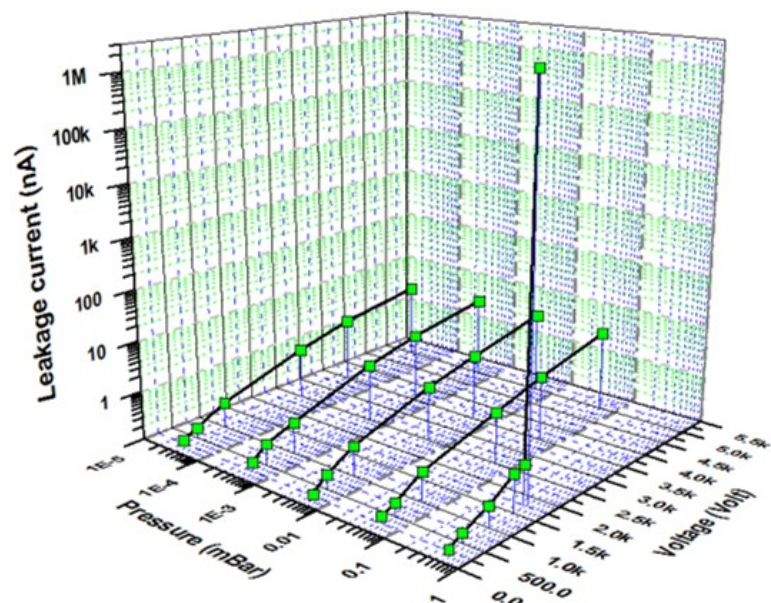
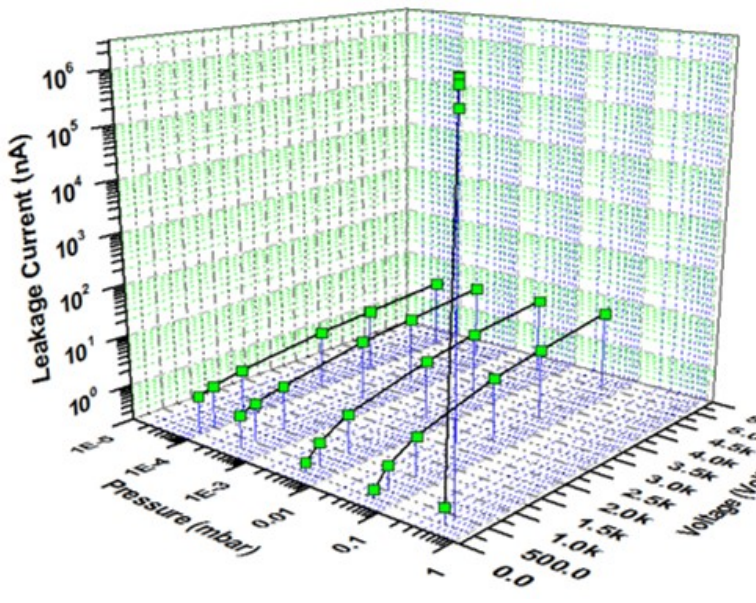
Time evolution of ADITYA-U shot (#34167), demonstrating 1.5 T toroidal field operation.



The vacuum isolator/barrier is a crucial electrical component for superconducting (SC) magnets for Tokamaks operating at cryogenic temperatures and at high current and voltage. The SC magnet terminals, housed inside the machine cryostat are connected to the cold end of current leads, which are housed in a separate vacuum chamber, and another to the warm end of it for room temperature (RT) electrical power from power supply. In case of high induced voltage on poloidal field (PF) magnets due to the Ohmic coil discharge, with the existing insulation in coils, current leads, and instrumentation feed-throughs, there is possibility of Paschen discharge, which can severely damage the current leads as well as magnet winding packs, when there is no vacuum isolation between cryostat and current leads vacuum chamber. The vacuum barrier isolates the vacuum of cryostat and the current leads chamber and also acts like electrical barrier for the propagation of Paschen discharge from current leads chamber to the magnet cryostat. Recently developed FRP insulation based axial as well as radial vacuum barrier (VB) for SST-1 PF#3 coil bus-bars has been tested in Paschen condition at RT and liquid nitrogen temperature. This VB has been tested for DC and SST-1 like induced voltage on PF coils under varying helium gas pressure. The DC and impulse test voltage up to 5 kV and 52 kV/s used at RT and at low temperature.



(L) The vacuum barrier (R) The Paschen test setup



Paschen test results of the VB setup (L) at 298K (R) at 91K

The National Science Day (NSD) was celebrated at IPR during 8-12 February, 2021. Due to the Covid-19 pandemic, all the programmes of NSD-2021 were conducted either as offline or online events. Competitions like essay and poster were conducted offline while those like eloquence, quiz and science models (for both teachers and students) were conducted online. The webinar facility of Outreach Division was used to conduct the online events.

No. of participating schools	51
No. of registered participants	100
No. of events organized	12
No. of prizes won	52

Top three schools in the NSD-2021	
1 st	New Era Senior Secondary School, Vadodara
2 nd	Maharaja Agrasen Vidyalaya, Ahmedabad
3 rd	Podar International School, Ahmedabad



The NSD-2021 quiz competition in progress



The NSD-2021 science model competition (for teachers) in progress

Prize	Name of the Student	Name of the School	Title of the Science Model
1st	Paavan Shah	New Era Senior Secondary School, Vadodara	Smart garbage collecting cart
2nd	Sommyartha Biyani & Ishita Gupta	D.P.S. Gandhinagar	Electric sanitizer dispenser
3rd	Dhruvika K Darji & Hiteshkumar V Makvana	Smt. K.D. Patel High School, Anand	Global warming and environment
Consolation	Dev V Tilak & Mayur V Pindoliya	H.J.D. Institute, Kutch	Accident avoidance using automated headlight dimmer

Prize	Name of the Teacher	Name of the School	Title of the Science Model
1st	Avinash Jayswal	S.N. Gurukul Vidyalaya, Ahmedabad	Centre of gravity
2nd	Aditya Kavalanekar	New Era Senior Secondary School, Vadodara	Demonstration of LCR Circuits
3rd	Mukesh Solanki	K. V. Rajkot	Demonstration of orbital & equatorial planes
Consolation	Arpita Modhsara	New Era Senior Secondary School, Vadodara	Tinkering with sound

Results of the science model competition (L) for students and (R) for teachers

In spite of the Covid-19 pandemic, there was good participation in the online events organized as part of the NSD-2021. Students who, by now, have had ample experience in on-line learning activities were found to be very comfortable participating in the online quiz, eloquence and science model competitions. Teachers also took active part in the competition for educational models in science.

Results of the Quiz competition

Prize	Student Name	Name of the School
1st	Nihar Mehta	Amrita Vidyalayam, Ahmedabad
2nd	Agarwal Kush Hans	Ahmedabad International School, Ahmedabad
3rd	Kunj D. Buddhdev	Utkarsh School Of Excellence, Rajkot
Consolation	Sneh Patel	New Era Senior Secondary School, Vadodara
Consolation	Raval Dipakbhai	Kendriya Vidyalaya CRPF Gandhinagar

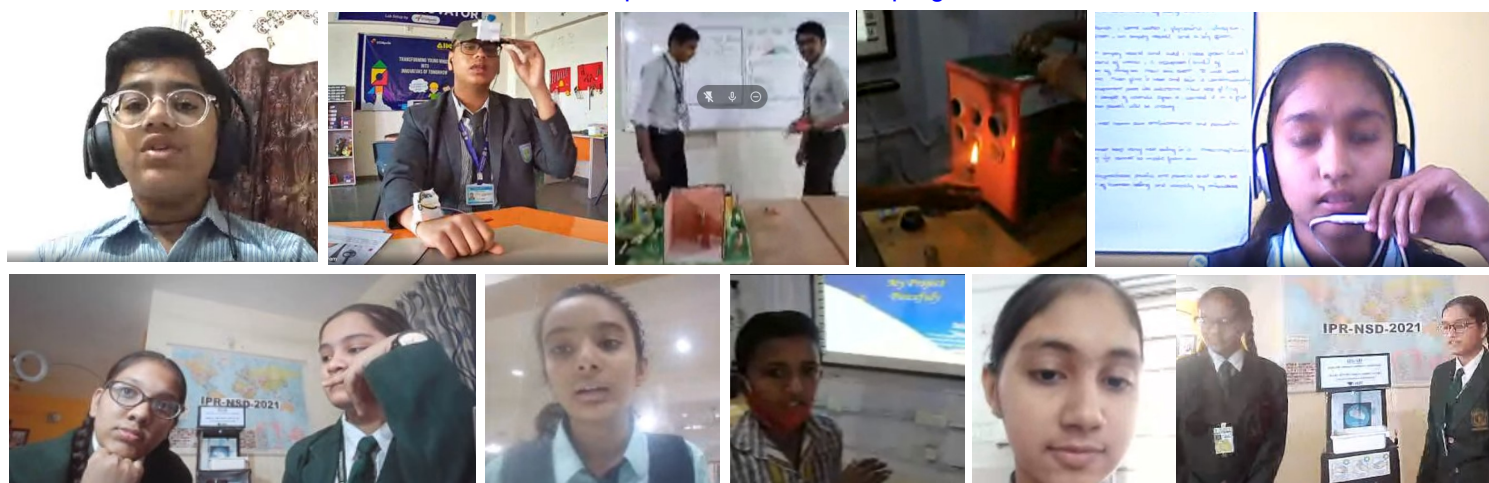
Instructions for Round 1

- Each team will be asked two questions. (2 sub round)
- Participated teams will get choice to select question number from available questions.
- Format is Objective questions with multiple choice
- 5 points for correct answer and no negative points for wrong answer.
- Answering time is only 90 seconds.
- No questions will be pass to the next team

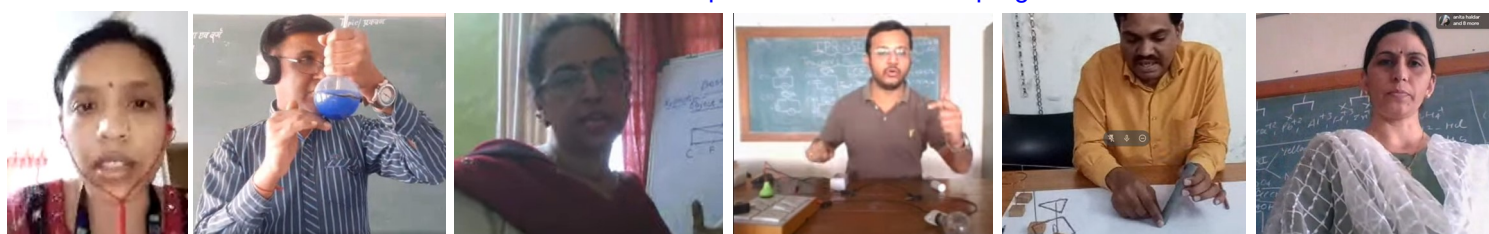
प्रत्येक टीम से दो प्रश्न पूछे जाएंगे। (2 सब-राउंड)
 भाग लेने वाली टीमों को उपलब्ध प्रश्नों में से प्रश्न संख्या का चयन करने का विकल्प मिलेगा।
 प्रारूप: बहुविकल्पी उत्तर वाले प्रश्न
 सही उत्तर के लिए 5 अंक और गलत उत्तर के लिए कोई नकारात्मक अंक नहीं।
 उत्तर देने का समय केवल 90 सेकंड है।
 अगली टीम के कोई सवाल पास नहीं होगा।

National Science Day - 2020
Institute for Plasma research

Quiz competition for students in progress



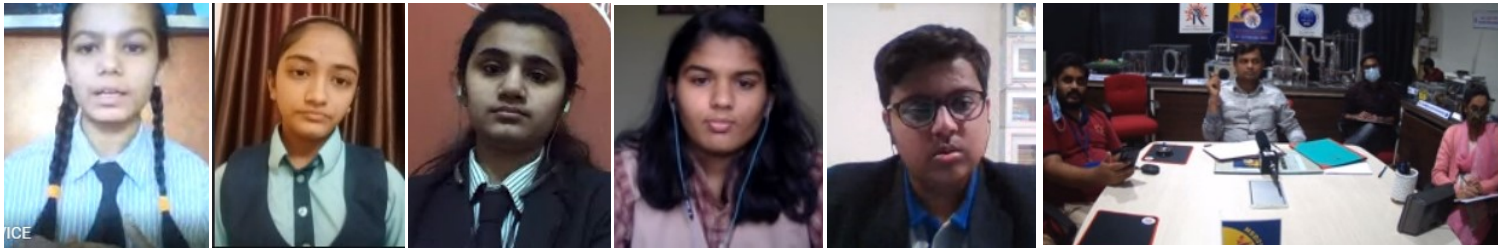
The science model competition for students in progress



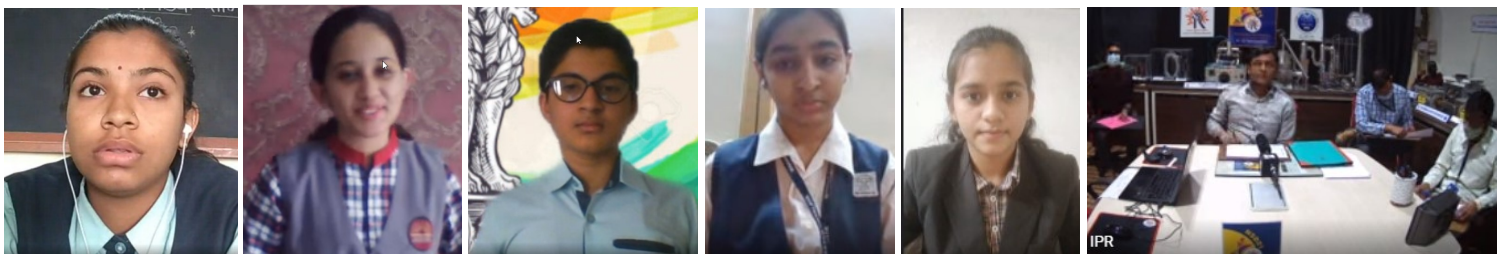
The science model competition for teachers in progress



The 1st prize winning entries of the Poster competition (Clockwise, from left) Kavya Bhansali (Gujarati), Raiyani Ni-yati (English) and Mohnani Megha (Hindi)



The finals of the Gujarati Eloquence competition in progress



The finals of the Hindi Eloquence competition in progress

The concluding ceremony was conducted online on 19-Feb-2021. Over 70 participants and teachers from various schools attended the event. Dr. P. K. Atrey, Dean R&D, IPR spoke to the participants and teachers. The prizes for the various competitions were also announced by him. The certificates were also distributed online to the winners of the various competitions. Following this, the participants shared their experiences and also gave their feedback on the NSD-2021.



Dr. P. K. Atrey addressing the participants during the concluding session of NSD-2021

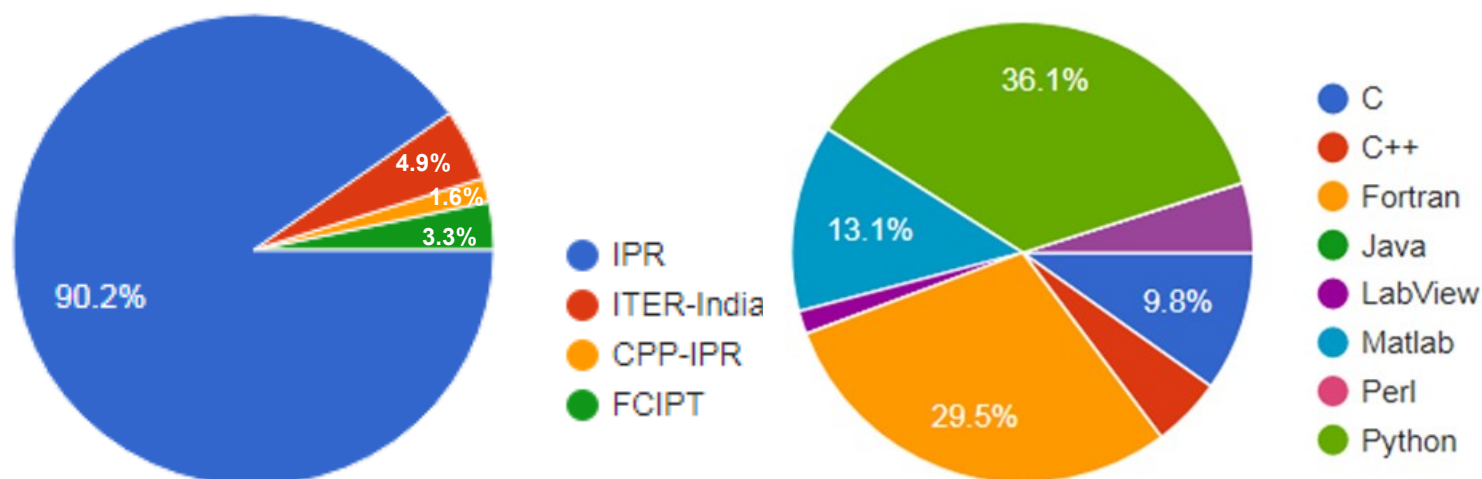


(Top) Teachers and (Bottom) Students participating in the concluding session of NSD-2021

IPR - A Different Panoramic Perspective



The emergence of Artificial Intelligence (AI) has provided an indispensable toolkit to make faster leaps in scientific research for the benefit of humanity. The availability of large volumes of data and at the same time the compute resources have laid down the path for the use of AI in pushing forward the boundaries of science. HPC Team, IPR along with the help from Nvidia Team planned an AI for Science Boot camp series intended to identify AI opportunities for the research work being carried out in various domains in IPR. The series-I of the AI for Science Boot camp was held during 11th-12th January 2021 at IPR. The event was completely online and took place for two half-days (11th-12th Jan) on our JITS platform. This was the first in a series of two boot camps. The Series-I focussed on the data-driven approach where the objective was to introduce researchers to how AI can accelerate their scientific simulation work with the availability of the HPC resources at IPR. To get familiar with the main concepts of Deep Neural Networks and the process of how to build, compare and improve the accuracy of the deep learning models, mostly hands-on lab sessions were carried out. The Boot camp familiarized two real-world problems, where the participants followed a step-by-step approach to learn the AI concepts and how they can be applied in real scientific applications. This boot camp brought together more than 55 participants over the course of two half-days out of a total of 61 registrations received from various divisions in IPR, FCIPT, CPP-IPR, and ITER-India having expertise with different domains/programming languages.



All the participants were given access to IPR's 1 Peta Flop HPC Cluster, ANTYA for carrying out the hands-on lab sessions. No GPU programming or AI knowledge was required for the participants. However basic experience with Python was needed. Day-1 (11th Jan) started with familiarizing the participants for connecting to the cluster, followed by an introduction to GPU computing and AI. For the lab sessions, a demonstration was shown on how to launch a “headless” Jupyter Notebook as a batch job in ANTYA and access the Graphical User Interface (GUI) in the Local user machine's (Desktop/Laptop) web browser. This allowed the participants to use the ANTYA compute resources and several Python packages installed in ANTYA without the need of installing anything on the local machine to run the Jupyter Notebook. Day-2 focussed on following step-by-step through the Jupyter Notebook of “Tropical cycle detection” to understand the model, training, and parameters involved in the prediction accuracy. This process gave the participants insight into how AI can be applied in their domains and how they can start using it from scratch. The level of engagement of the participants with the trainers showed their enthusiasm and eagerness to learn AI and its application to accelerate their work. The series-II of the AI for Science Boot camp will focus on the Physics Driven Neural Network and is tentatively planned for the 1st week of March 2021.

All the material of this AI boot camp for science series-I is available and can be downloaded from the [GitHub repository](#).

The screenshot shows the agenda for the AI Science Bootcamp IPR. The agenda is divided into four sections: INTRO TO DL, PART 1; LAB 1: CNNs AND KERAS 101; LAB 2: TROPICAL CYCLONES; and LAB 3: TC CHALLENGE. The first section features a cartoon robot character. The second section shows a Fashion MNIST dataset with Keras. The third section shows a tropical cyclone image. The fourth section shows a line graph of accuracy over time. The word 'AGENDA' is displayed at the bottom.

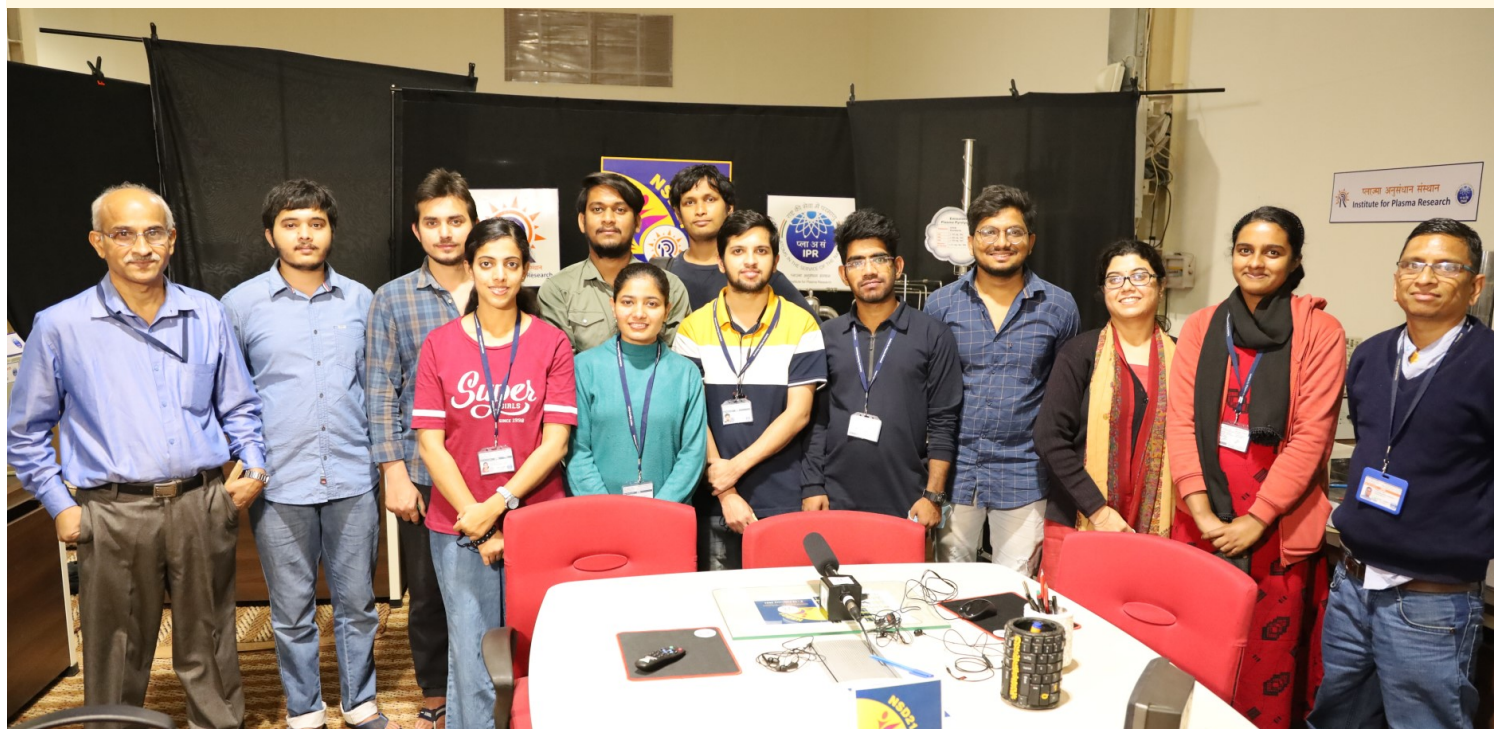
The package termed as In-Wall Shielding (IWS) is a complex assembly of ~9000 borated and ferromagnetic steel blocks. It is one of the in-kind contribution from India to ITER Project. The IWS block assemblies sandwiched between the double walls of the vacuum vessel of the ITER machine and perform the important function of shielding the components from neutrons and contribute to plasma performance by limiting perturbations due to toroidal field ripple. The last batch of components has been manufactured at L&T Hazira and dispatched to ITER.

To commemorate the completion of manufacturing and for the flag-off of last shipment, a ceremony was organized on 16th December 2020 with limited in-person participation and wider remote participation. In spite of the challenges of the pandemic situation, the manufacturing activities continued and concluded successfully, with the excellent collaboration between ITER -India, L&T Hazira and ITER Organization.



Images from the “Flag-off Ceremony” of the final shipment of ITER in-wall shielding from Hazira, Gujarat

The new batch of IPR PhD scholars visited the Outreach exhibition on 10th February, 2021 as part of their PhD course work “Plasma production and measurements (PPM-I)” conducted by Dr. N. Ramasubramanian. The students got to see the various interactive plasma exhibits and the models of generic tokamak as well as SST-1 during the extended interaction with ORD staff.

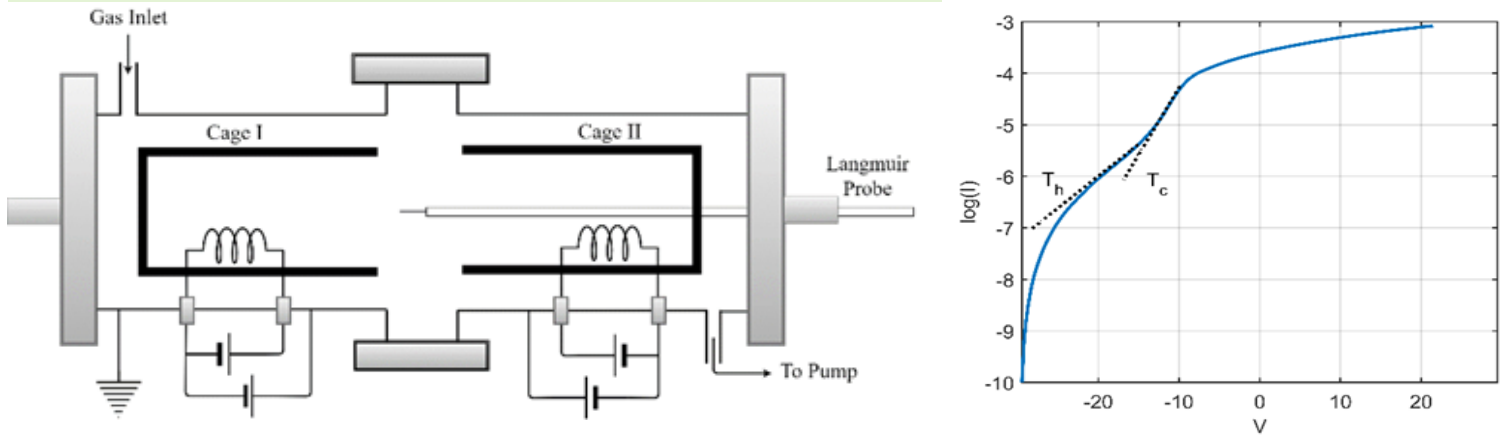


(L-R) K K Mohandas (ORD), Kunal Singha, Sagar Chaoudhary, Savita, Trivesh Kant, Geethika, Udaya Maurya, Bharat Hedge, Ashokkumar Kumawat, Kaushalkumar V. Parikh (PhD students), Ananya Kundu (IPR staff PhD student), Varsha S (PhD student) and Narendra Chauhan (ORD)

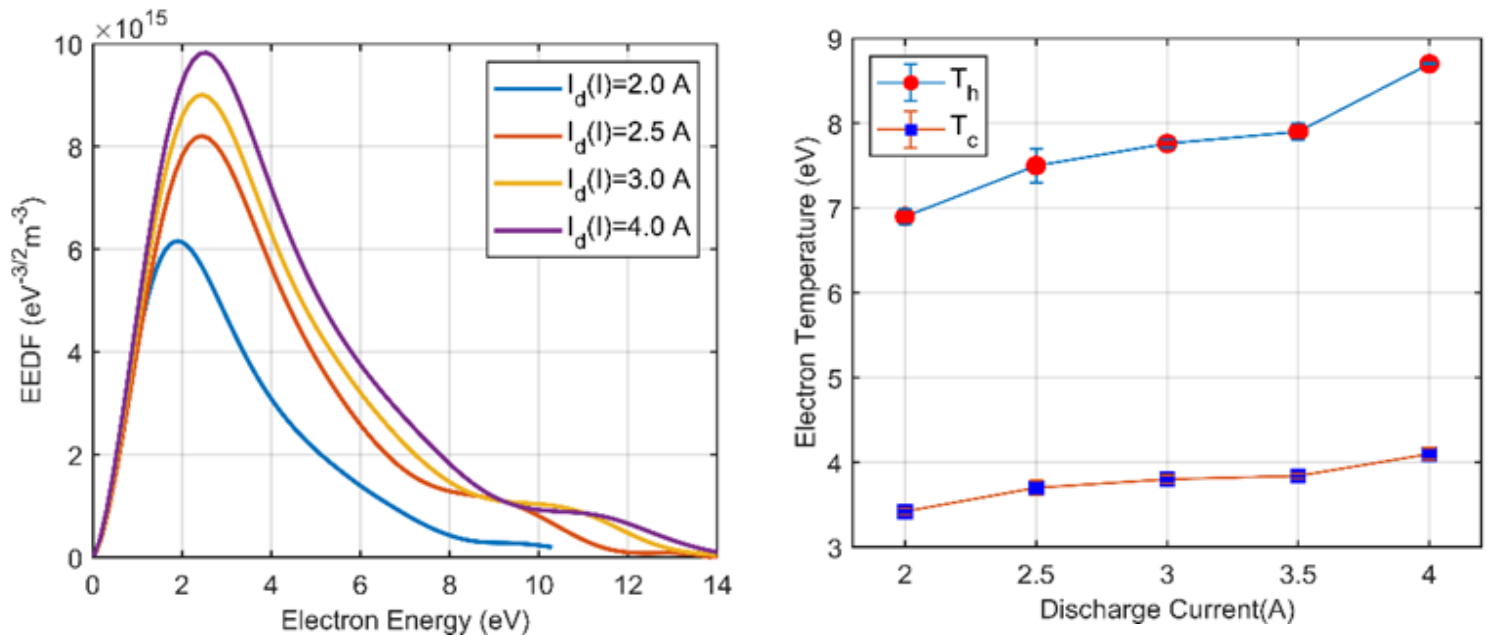


IPR PhD students at the ORD exhibition

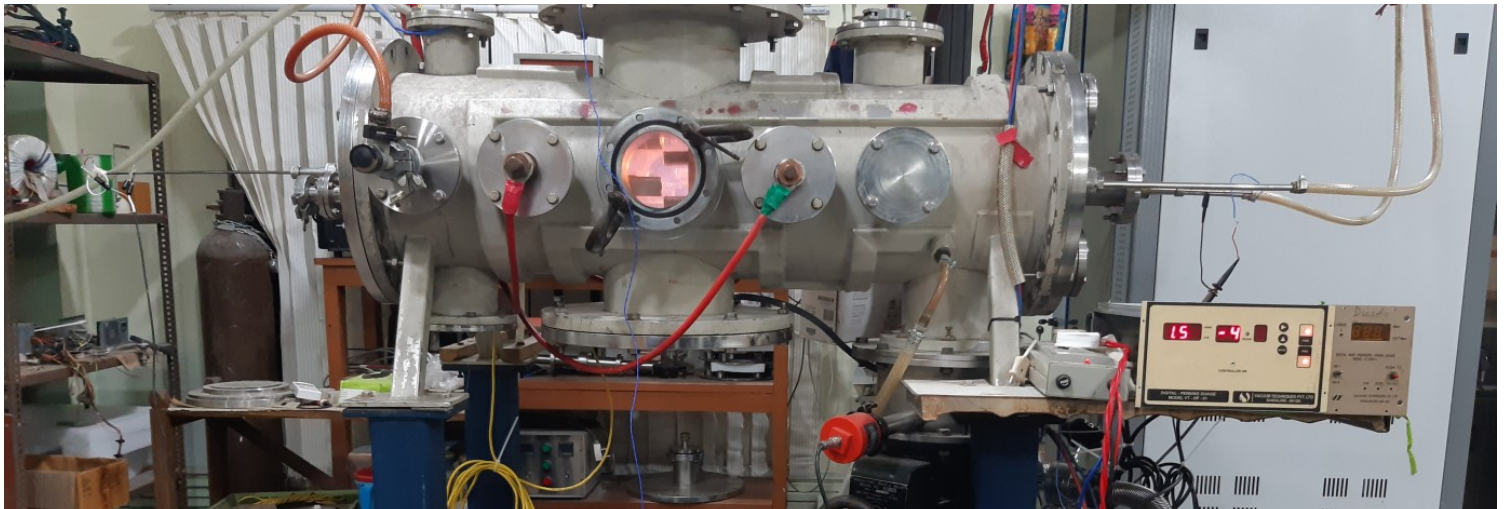
A new method has been developed for controlled production of a two-electron temperature plasma. It uses a simple technique of diffusing two plasmas having different characteristics. Plasmas of varied nature are produced in a cylindrical stainless steel chamber by using two full line cusp magnetic cages of different surface field strengths. Plasmas from both the cages are allowed to diffuse in the central region of the chamber. A cylindrical Langmuir probe is used to determine the plasma parameters in the diffusion region. To observe two electron population with two different energies, the discharge currents in both the cages are varied. In other words, the applied current to the filaments is changed. The semi-logarithmic plot of current vs. voltage characteristic has two distinct slopes indicating the presence of two-electron groups. The electron energy distribution function (EEDF) is calculated and plotted. EEDF plots for various discharge currents in cage I reveal that for higher discharge currents in cage I, hot electron population significantly rises which is evident from the bump on the tails of EEDF curves. The developed system is simple and provides adequate control over the densities and temperatures of both the electron groups. A team comprising of Mr. Gunjan Sharma, Mr. Kishor Deka, Ms. Rupali Paul, Dr. S.S. Kausik, Prof. B.K. Saikia from CPP-IPR, Dr. S. Adhikari (University of Oslo, Norway) and Dr. R. Moulick (Rangapara College, Assam) was associated with this work.



(L) Schematic diagram of the experimental system (R) Semi-logarithmic I-V curve



(L) EEDF for various discharge currents (R) Electron temperature variations vs. discharge current for the two electron groups



- ◆ **Mr. Vinit Shukla**, gave an invited talk on “*ITER Project and Cryogenic Aspects in Fusion Energy*” at Ajay Kumar Garg Engineering College, Ghaziabad, 8th January 2021
- ◆ **Mr. Rajiv Sharma**, gave a talk in Hindi on “*क्रायेजेनिक संयंत्र एवं घटकों का स्वदेशीय विकास - नाभिकीय संलयन द्वारा भविष्य ऊर्जा स्रोत की दिशा में भारत की आत्मनिर्भरता*” at All India Hindi Scientific webinar on “Journey Towards Self-Reliant India - Role of Science & Technology”, IGCAR, Kalpakkam, 11-12 January 2021
- ◆ **Dr. Sarveshwar Sharma**, gave an invited talk on “*Driving frequency effect on the plasma parameters and electron heating in very high frequency (VHF) capacitive discharges*” at 8th ICMAP (International Conference on Microelectronics and Plasma Technology) & 9th ISFM (International Symposium on Functional Materials), Korea, 17-20 January 2021
- ◆ **Mr. Hariprasad MG**, Institute for Plasma Research, Gandhinagar, gave a talk on “*Experimental Investigation of Complex Plasma Crystals in a DC Glow Discharge Plasma*” on 22nd January 2021
- ◆ **Dr. Mahesh V. P.**, IIT, Gandhinagar, gave a talk on “*Mechanical and Electrochemical Performance of Aluminium Matrix Friction Stir Surface Composites*” on 22nd January 2021
- ◆ **Dr. Sandeep Rimza**, CIPET, Ahmedabad, gave a talk on “*Design and Development of Helium Cooled Heat Sink Mock-up for Tokamak based Fusion Reactor Applications*” on 29th January 2021
- ◆ **Mr. N. I. Jamnapara**, gave an invited talk on “*Plasma Technology as Green Manufacturing Alternative - Application Overview*” at GUJCOST-DST sponsored webinar on “Green Manufacturing Processes” organized by Government Engineering College Gandhinagar, Metallurgy Department, on 30th January, 2021
- ◆ **Dr. Basanta Kumar Parida**, FCIPT, Institute for Plasma Research, Gandhinagar, gave a talk on “*Study of Boron Nitride Erosion Behaviour at Elevated Temperature*” on 2nd February 2021
- ◆ **Dr. Umesh Kumar Gaur**, PSED Division, FCIPT, IPR Gandhinagar, gave a talk on “*Magnetic nanostructures for anisotropic and supercapacitive studies*” on 2nd February 2021
- ◆ **Mr. Arunsinh B. Zala**, Institute for Plasma Research, Gandhinagar, gave a talk on “*Investigations on Weldability of Aluminide Coated 9Cr steels*” on 4th February 2021
- ◆ **Dr. Rajashree Sahoo**, Kalinga Institute of Industrial Technology, Bhubaneswar, gave a talk on “*Heterogeneous Photocatalytic dye degradation using Zinc Oxide (ZnO) Semiconductor nanoparticles prepared from its Laboratory grade powder*” on 5th February 2021
- ◆ **Mr. Yogesh M. Jain**, Institute for Plasma Research, Gandhinagar, gave a talk on “*Design, Development and Characterisation of a Passive Active Multijunction RF Launcher Compatible with ADITYA –Upgrade Tokamak*” on 5th February 2021
- ◆ **Dr. Jervis Ritesh Mendonca**, Institute for Plasma Research, Gandhinagar, gave a talk on “*Numerical studies of sheared flow effects on visco-resistive MHD instabilities and application to ADITYA-U results*” on 8th February 2021
- ◆ **Dr. Falguni G Bhabhor**, Institute for Plasma Research, Gandhinagar, gave a talk on “*Surface modification of Aramid fiber by plasma treatment for property enhancement studies*” on 10th February 2021
- ◆ **Dr. Amitkumar Patel**, Institute for Plasma Research, Gandhinagar, gave a talk on “*Excitation of an ion acoustic soliton in quiescent Argon plasma confined by Multi-pole cusp magnetic field*” on 10th February 2021
- ◆ **Dr. Nageswara Rao Epuru**, Institute for Plasma Research, Gandhinagar, gave a talk on “*Developments of Laser Photo-detachment experiment for the detection of O- and H- density in the SPIN-X plasma device*” on 11th February 2021
- ◆ **Dr. Sheetal Punia**, Indian Institute of Technology Delhi, gave a talk on “*Tunable THz Radiation and Positron Generation by Dark Hollow Laser Beams*” on 12th February 2021
- ◆ **Mr. Jasraj Dhongde**, Institute for Plasma Research, Gandhinagar, gave a talk on “*Design and Development of SFP based Prototype Timing System for Steady State Superconducting Tokamak (SST-1)*” on 16th February 2021
- ◆ **Dr. Ritu Dey**, Institute for Plasma Research, Gandhinagar, gave a talk on “*Simulation of edge-plasmas of ADITYA-U tokamak using UEDGE code*” on 17th February 2021
- ◆ **Dr. Vaishnavi Tiwari**, University of Paris-Saclay, France, gave a talk on “*A consistent approach for coupling lumped-parameter and phase-field models for in-vessel corium to thermodynamic databases*” on 19th February 2021
- ◆ **Mr. Montu Prafulbhai Bhuvra**, Institute for Plasma Research, Gandhinagar, gave a talk on “*Magnetic field effects on Cold Hollow Cathode DC Discharge – An Experimental and Modeling Study*” on 22nd February 2021

Upcoming Events

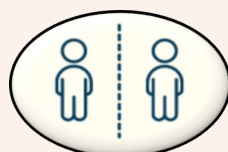
- ◆ 3rd International Conference on Data-Driven Plasma Science (ICDDPS-3), jointly held with 12th EU-Japan Joint Symposium on Plasma Processing (JSPP-12) and the 15th Asia-Pacific Conference on Plasma Science and Technology (APCPST-15), (Virtual), Japan, 29 March 2021 - 02 April 2021 <http://www.ppl.eng.osaka-u.ac.jp/ICDDPS3/>
- ◆ 47th IOP Plasma Physics Conference, Institute of Physics, London, United Kingdom, (Virtual), 06-09 April 2021 <http://plasma2021.iopconfs.org/home>
- ◆ ANS Student Conference (ANS 2021), (Virtual), United States, 08-10 April 2021 <https://www.ans.org/meetings/student2021/>

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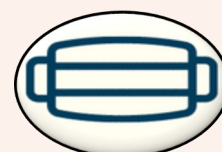
Help Fight The Covid-19 Pandemic



**Wash Your Hands
With Soap**



**Ensure Social
Distancing**



**Always Wear
Mask**

- ◆ Avoid touching your eyes, nose and mouth
- ◆ If you have fever, cough and difficulty in breathing, seek medical care early
- ◆ Stay informed and follow advice given by your healthcare provider

- ◆ Inform Office immediately if you or any family member tests positive
- ◆ Follow SMS - **S**ocial Distancing : **M**ask : **S**oap/Sanitizer
- ◆ Strictly follow social distancing while outdoors, especially at work.

For your safety and for the safety of your co-workers, ensure that you always use Arogya Setu App

Know Your Colleagues



Shri. Mukesh Chandra Jha joined IPR in 2004 from DRDO as a Scientist-SC. He was initially working with Dr. Dilip Ahalpara on the in-house development of integrated software like PAST (for procurement and Inventory management). Later on he developed the PASTA system for employee leave management and OBS master data. He is currently associated with different sections like purchase, stores, administration & accounts section for development of various in-house software for administration purchase/store applications. Presently he is with the Project Management Cell and associated with the activities of various R&D projects at IPR.

The IPR Newsletter Team

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