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The Fourth State

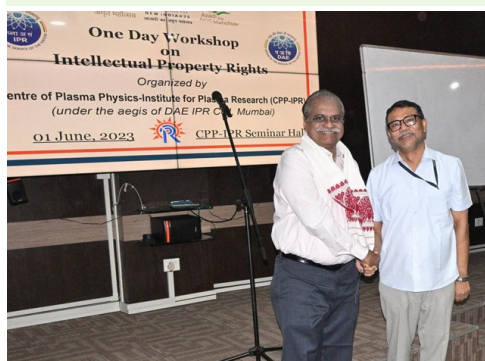
Newsletter of the Institute For Plasma Research, Gandhinagar, Gujarat (India)



One-Day Workshop on Intellectual Property Rights @ CPP-IPR

One-Day Workshop on “**Intellectual Property Rights**” was organized by Centre of Plasma Physics-Institute for Plasma Research (CPP-IPR) under the aegis of DAE IPR Cell, Mumbai at **CPP-IPR Campus**, Guwahati, Assam on **June 1, 2023**. Dr. Saikia delivered the introductory note to the workshop. Dr. Nirav Jamnapara gave an overview of the Technology Transfer activities of IPR and specifically explained about the start-up and incubation activities being pursued by IPR. Mr. Saroj Das explained about the activities undertaken by the IPR TTIP committee. Shri. Dani P. Rajiah, Member Secretary, DAE IPR Cell, has given series of lectures on introduction to Intellectual Property (IP), various types of IP, Patenting Procedures, non-patentable inventions, Patent Cooperation Treaty (PCT) filing, etc. At the end Shri Dani has also discussed about the DAE’s Experience with Patenting.

The workshop was attended by 60 participants, of which 48 were from CPP-IPR and 12 from various Institute / Universities like University of Science & Technology (USTM), Meghalaya; Dr. Bhubaneswar Borooah Cancer Institute (BBCI), Assam Don-Bosco University (ADBU), Assam Science Technology & Environment Council (ASTEC) and Royal Global University (RGU).



Images from the Workshop on Intellectual Property Rights held at CPP-IPR

Superconducting Tokamaks utilize very strong magnetic field for confining fusion grade plasma. The superconducting (SC) magnet system in a Tokamak comprises of low temperature superconductor (LTS) based electromagnets connected with SC current feeders system. High Temperature Superconductors (HTS) based current feeders system have potential benefits in terms of better temperature margin, less cryo operational cost and better cryo-stability for operating large scale SC magnets. The heat exchanger of HTS CL can use much cheaper cryogen as liquid nitrogen at around 77 K in lieu of liquid helium (4.2 K). The scarcity of liquid helium in the market makes HTS a prominent candidate for future SC applications. Magnesium diboride (MgB₂) is a promising candidate that become superconductor near 39 K, since it provides an option to cool using gas helium at 10 K to 30 K resulting in cost reduction for such applications. MgB₂ has lower raw material cost, ease of availability, low specific weight and lower density than other SC materials.

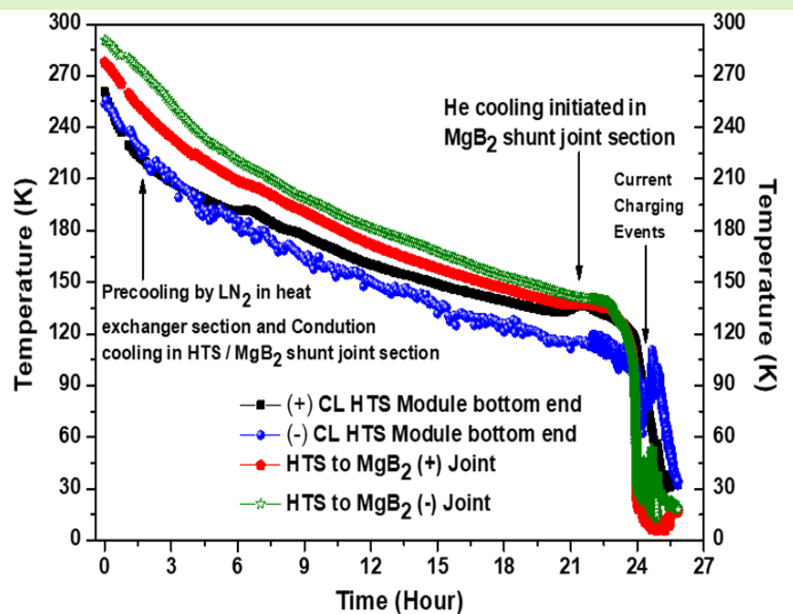
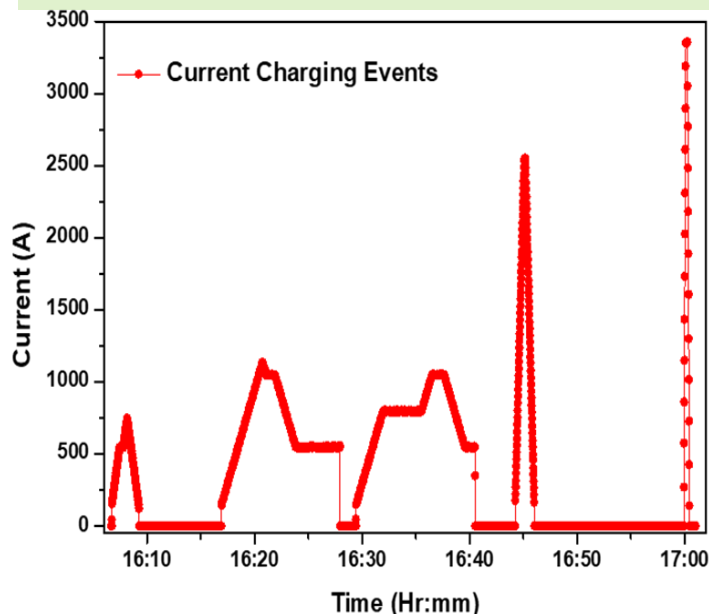
Recently, a prototype 3.3 kA rated prototype HTS CL pair was tested at IPR using an in-house developed meter-long MgB₂ shunt. The HTS module explores BISCCO-2223 tapes with its critical temperature of 110 K at self-field. The HTS CL were assembled in a dedicated experimental test cryostat having precise instrumentation and diagnostics. After achieving a high vacuum of the order of 10⁻⁵ mbar in test cryostat and ensuring prior checks following standard cryo-magnetic protocols.

The heat exchangers and copper thermal shields were cooled near 77 K using liquid nitrogen. The HTS modules of the CL along with MgB₂ joints section was cooled to its lowest possible temperature by radiation as well as conduction cooling from bottom part of the heat exchanger, thus saving the consumption of liquid helium. These tests required only 100 Lt of liquid helium, thus establishing that the conduction cooling mechanism to cool MgB₂ joints section as part of pre-cooling, was very effective.



HTS CL test cryostat equipped with necessary instrumentations along with liquid helium Dewar connected to the test assembly

The hybrid CL and the bottom MgB₂ shunt were tested in cold conditions up to its full rated 3.3 kA. During the test, all the sub-systems including vacuum, cryogenics, power supply, instrumentation and control system have successfully demonstrated their reliable operation. The test cryostat equipped with instrumentations along with the liquid helium Dewar connected to the test assembly using vacuum-jacketed flexible transfer siphon is shown in figure below. The current charging tests were carried out in the range of 750 A – 3350 A at a ramp rate of 5 A/s - 300 A/s using 12 kA/16 V Switch Mode Power Supply. The test results of prototype HTS CL are promising for the pulsed SC coils operation even using gaseous helium cooling. This demonstration could provide the way forward and cost effective solution for future large-scale fusion, accelerators and MRI application as the CLs are major consumer of cold capacity.



(L) Current charging trends for HTS CL with MgB₂ joints section (R) Cool down trends for HTS CL pair

केन्द्रीय लोक निर्माण विभाग (CPWD), गांधीनगर में दिनांक 8 जून 2023 को हिंदी कार्यशाला का आयोजन किया गया। इस कार्यशाला में प्रशिक्षण देने हेतु प्लाज्मा अनुसंधान संस्थान की हिंदी अधिकारी श्रीमती संध्या दवे को “हिंदी टिप्पण और आलेखन तथा कार्यालयीन काम-काज में प्रयोग में आने वाली हिंदी व अंग्रेजी वर्तनी” विषय पर प्रशिक्षण देने हेतु आमंत्रित किया गया। श्रीमती संध्या दवे ने कार्यशाला में राजभाषा नीति के महत्व पर प्रकाश डालते हुए इस विषय पर विस्तार से चर्चा की एवं कार्यालय में उपयोग किये जाने वाले टिप्पण एवं आलेखन के नमूनों को प्रदर्शित किया। साथ ही उन्होंने तकनीकी विषय का जटिल अनुवाद करने के बदले सरल भाषा में उसे प्रस्तुत करने और लोकप्रिय अंग्रेजी शब्दों का लिप्यांतरण कर उनका उपयोग करने का सुझाव दिया। कार्यशाला के दौरान उपस्थित कर्मिकों द्वारा पूछे गये प्रश्नों का हल भी प्रस्तुत किया एवं उन्हें हिंदी में सरलता से बिना किसी झिझक के कार्य करने के लिए प्रोत्साहित किया गया।

Academic Visits to CPP-IPR

Date	Institution	Visitors
26-May-2023	Department of Mathematics, Royal Global University, Guwahati, Assam	44 students of BSc, 10 students of MSc and 5 faculty
07-June-2023	Department of Physics, Royal Global University, Guwahati, Assam	14 students of BSc, 18 students of MSc and 3 faculty



Students and faculty from the Dept of Mathematics, Royal Global University, Guwahati, during their visit to CPP-IPR



Students and faculty from the Dept of Physics, Royal Global University, Guwahati, during their visit to CPP-IPR





A 2-day, Innovative TB Health Technologies Workshop was organized by the Indian Council of Medical Research (ICMR) and World Health Organization (WHO) at the ICMR headquarters, New Delhi during 15-16 June, 2023. The aim of the meeting was to categorize the technologies with aim to provide support for TB Healthcare with Innovative healthcare technologies with Health technology assessment. Various innovators presented the technology and experts assessed by scoring criteria. The workshop was attended by Union Minister of State for Health and Family Welfare, Prof. S P Singh Baghel, the Union Health Secretary, Shri Rajesh Bhushan and several other dignitaries from ICMR and WHO as well as several medical innovators from across the country.

IPR was invited as one of the innovators to present technology for TB health at this workshop. Ms. Manika Sharma and Mr. Abhishek Sharma from Multidisciplinary Research Division, IPR, attended the meeting and presented AI based technology developed by IPR for TB management.

Executive Council for IPR Staff Club 2023-24

The newly elected members of the IPR Staff Club Executive Committee took charge during the General Body meeting of the IPR Staff Club which was organized at IPR seminar hall on 21 June, 2023. Prior to that, the outgoing committee presented a brief of the activities carried out by the Staff Club in 2022-23 as well as the balance sheet of the Staff Club accounts.



President

Ms. Karishma Qureshi



General Secretary

Dr. Jyoti Shankar
Mishra



Cultural Secretary

Mr. Rajnikant Bhatasana



Sports Secretary

Mr. Vishwarshi Maurya



Treasurer

Mr. Parag Panchal



The outgoing members of the IPR Staff Club Executive committee and the new committee members with Dean Administration, Dr. Subroto Mukherjee

Date	Institution	Visitors
25-May-2023	Participants of the Yuva Vigyani Karyakram (YuViKa) of SAC,ISRO, Ahmedabad	54 students from 9-11 stad science students and 7 faculty members
25-May-2023	Government MCA College, Ahmedabad	42 students pursuing MBA and 2 faculty members
21-Jun-2023	Participants of IPR Summer School Programme 2023	16 students of MSC Physics and Engineering



Participants of the YuViKa programme of SAC-ISRO during their visit to IPR



Participants of the IPR Summer School Programme 2023 during their visit to Outreach exhibition

IPR outreach conducted a week long scientific outreach programme at Agartala in Tripura. The programme was organized at the ICFAI University Tripura at Agartala (Tripura), in association with the Department of Physics, ICFAI University and the Indian Association of Physics Teachers (IAPT) and on during 5-8 June, 2023. This is IPR's first outreach activity in the state of Tripura. The programme consisted of an exhibition on plasma, its applications as well as a training programme on plasma & its applications for science teachers. The event was inaugurated by Shri N. C. Sharma, Director, Higher Education, Government of Tripura. The 4-day exhibition was attended by over 600 students of schools in Agartala as well as students from the ICFAI University. As part of the event, a competition of the game "Operation Tokamak" was also organized for school and college students. Fifty students of BSc Physics from ICFAI University were trained by IPR team to explain the exhibits to visitors. More details [HERE](#).



Inauguration of the Plasma Exhibition at ICFAI University, Agartala (Tripura)



The Plasma Exhibition at ICFAI University in progress



Student volunteers explaining the plasma exhibits to visitors



Training the student volunteers



Visitors at the Plasma Exhibition



Training programme for science teachers in progress

The ITER Diagnostic Neutral Beam (DNB) system is designed to deliver 100 keV, 18–20A hydrogen neutral beam to the ITER plasma. The beams are used to diagnose the He ash content during the DT phase of the ITER Machine. The MW neutral beam is realized through an eight driver based RF negative Ion source coupled to a 3 grid extractor and accelerator system along with the Beam Line components, placed inside the Vacuum Vessel of DNB. The assembly is pumped with the help of cryosorption based 1 million liter/s cryopumps lining the vessel walls on either side of the beam line components.

The BLC's consists of a neutralizer (Figure 1), electrostatic residual ion dump (Figure 2) and a calorimeter (Figure 3). In order to enable performance testing of the neutralizer and electrostatic residual ion dump, the components manufactured as per ITER specifications shall be performance tested on the Indian test facility at ITER India lab, IPR prior to shipping to ITER. The components are first of kind in terms of their dimensions, overall weight, special materials and manufacturing technologies to comply with the safety and quality norms of ITER. BLCs have been manufactured to meet EN/ISO standards, ITER Vacuum Handbook and ASME codes requirements. During manufacturing of BLC's the following technologies and relevant materials were developed and implemented.

- ITER grade CuCrZr material has been developed in collaboration with NFTD Hyderabad under an MoU. Major highlights are controlled Cr (0.6 to 0.8%) and Zr (0.07 to 0.15 %), overall impurities not exceeding 0.1% and limitation of Oxygen content up to 25 ppm.
- Deep drilling with the drift control of 0.5mm over the length >1.5m length
- Dissimilar material water to vacuum boundary of CuOf/CuCrZr to SS is realized through Electron Beam Welding (EBW) to ensure the reliability throughout the operational life of the components. The parameters welding parameters have been developed through extensive trials, prototyping and production proof samples. The developed joints have been qualified for leak tightness of 10^{-9} mbarl/s and for a pressure holding of 25 bar at elevated temperatures of 150 °C. The EB joints not only satisfy the ASME / EN standards but also meet additional quality and safety requirements of ITER and similar future fusion machines
- Heat transfer elements made from CuCrZr and involving precision machining of cooling fins and EBW of similar, CuCrZr-CuCrZr and dissimilar, CuCrZr-Ni-SS, metal joints with leak tightness of 10^{-9} mbarl/s.
- Detailed procedures related to Hot Helium leak tested have been established to demonstrate the desired compliance.

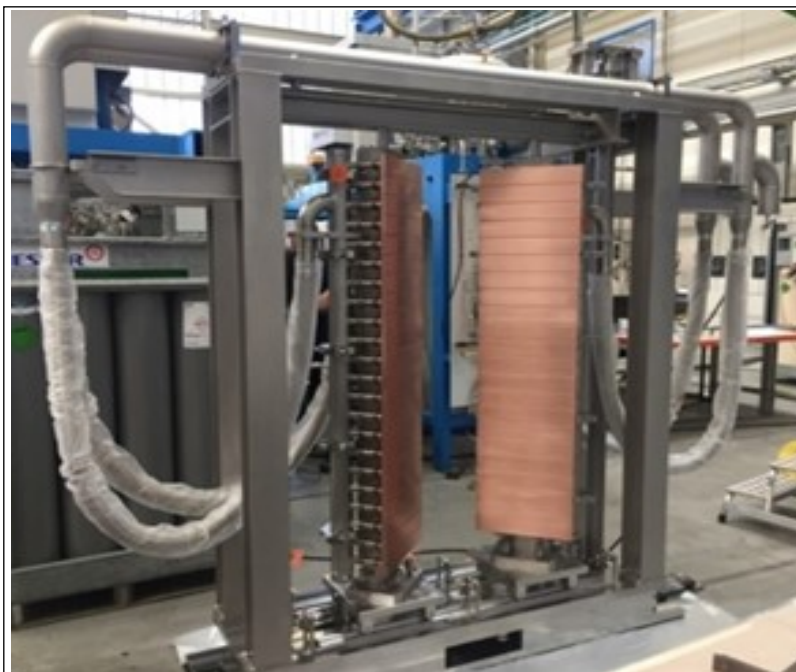


1 m long, 1.8 m high, 5 ton, Residual Ion Dump consisting of an assembly of 50 individual water cooled elements of CuCrZr to separate ionic component of the beam from the neutrals. Alternate panels of the assembly at high voltage and ground potentials.



3 m long, 1.8 m high, 17 ton, 5 panel Neutraliser for DNB. Each panel is an assembly of consisting of 1 m long sub-panels made from CuOF. The panels are water cooled using a serpentine pattern of the deep drilled water channels in the horizontal and vertical direction. Extensive use of EBW is used to close the open channels in panels and for realising CuOF-Ni-SS transition for connecting the component to the cooling water system (view from downstream side)

Factory acceptance tests of these components have been recently completed at the works of the manufacturer, M/S PVA Tepla Germany and found to be compliant with the desired quality norms. The manufacturing of the BLCs have been preceded by a prototype phase where technologies for material, machining and Electron Beam Welding have been developed and fully characterized in an R&D phase, resulting in a comprehensive understanding of all the processes involved. This exercise has enabled the realization of the BLCs with significant contributions from ITER-India engineers on process related matters.



1.8 m high, 3 ton, 2 panel calorimeter assembly. Each panel is a stacked assembly of 22 HTE's made from CuCrZr. EBW has been extensively used to realise CuCrZr-CuCrZr and CuCrZr-Ni-SS joints of each HTE.

- ♦ **Ms. Bharathi Mangesh**, gave an overview talk on "Overview of Doppler Shift Spectroscopy Diagnostics Technique used in Neutral Beam Injectors - Challenges & Limitations" at 21st International Conference on Atomic Processes in Plasmas, IAEA headquarters, Vienna, 16-19 May 2023
- ♦ **Ms. Sapna Mishra**, gave an overview talk on "IN-DA Progress Report" at 43rd Meeting of the ITPA Topical Group on Diagnostics, Eindhoven DIFFER Site, Netherlands, 22-25 May 2023
- ♦ **Dr. Sudheer**, gave a talk on "Graded oxide layer for high-performing nanosized synaptic emulator" on 25th May 2023
- ♦ **Mr. Satadal Das**, gave a talk on "Studies on external electrode influence on magnetized plasma properties in linear device" on 26th May 2023
- ♦ **Dr. Raghavendra Darji**, M. S. University, Baroda, gave a talk on "Joining of thick Cu plate using Hot Wire Gas Tungsten Arc Welding" on 26th May 2023
- ♦ **Dr. Arunsinh B. Zala**, gave a talk on "Development of Aluminide coating on Ni based super-alloys" on 29th May 2023
- ♦ **Dr. Poonam Gawali**, gave a talk on "The effect of cold atmospheric plasma jet in Hamster-buccal-pouch carcinogenesis: A Serum Raman spectroscopy study" on 02nd June 2023
- ♦ **Mr. Vivek Pachchigar**, gave a talk on "Superhydrophobic surfaces developed through argon plasma processing for self-cleaning and water harvesting technologies" on 05th June 2023
- ♦ **Dr. Chandrakanta Singh**, Kalinga Institute of Industrial Technology (KIIT), Bhubaneswar, gave a talk on "Formation and Characterization of N₂ Nanosecond Pulsed Laser Induced Black Silicon (LibSi) for Optoelectronics Application" on 6th June 2023
- ♦ **Ms. Shruti Kumari**, Central Institute of Petrochemical Engineering and Technology (CIPET), Vatva, Ahmedabad, gave a talk on "Development of Superhydrophobic PTFE Polymer Surface using Oxygen Plasma Processing" on 9th June 2023
- ♦ **Mr. Vijay Shankar**, gave a talk on "Control of edge and Scrape-off layer Tokamak plasma Turbulence" on 13th June 2023
- ♦ **Dr. Pravesh Dhyani**, gave a talk on "External-q Experiments in Current-less Plasma of Basic Experiments in Toroidal Assembly (BETA)" on 14th June 2023
- ♦ **Dr. Roshin Raj Sheeba**, Physics of the Interactions of Ions and Molecules (PIIM) Laboratory, Aix-Marseille University, France, gave a talk on "Synthetic diagnostics for plasma spectroscopy of magnetic fusion devices" on 16th June 2023
- ♦ **Mr. Milaan Patel**, gave a talk on "Development of pulsed supersonic beam system for tokamak edge diagnostics and other applications" on 22nd June 2023
- ♦ **Dr. Kajal Garg**, gave a talk on "Investigating Runaway Electron Dynamics and Hard X-ray Emission in ADITYA Tokamak Plasma: A Limiter-Based Analysis" on 23rd June 2023

Upcoming Events

- ♦ Nuclear Corrosion Summer School (NuCoSS-23), Gozd Martuljek, Slovenia, 2-7 July 2023; <https://ecg-comon.org/meetings/nucoss/>
- ♦ One-Week High-End workshop on "Advances in Metal Additive Manufacturing: Fundamentals, Modeling, and Materials with Future Research Potential", National Institute of Technology Calicut, Kerala, 2-8 July 2023; <https://forms.gle/fiezkgisPw3LKdTt6>
- ♦ 49th European Conference on Plasma Physics, Bordeaux, France, 3-7 July 2023; <https://epsplasma2023.eu/>
- ♦ 38th Annual Decommissioning & Radioactive Waste Management Summer School, Cambridge, United Kingdom, 3-7 July 2023; <https://informaconnect.com/decommissioning-and-radioactive-waste-summer-school/>
- ♦ International Conference on Green Hydrogen (ICGH-2023), Vigyan Bhawan, New Delhi, 5-7 July 2023; <https://www.icgh.in/>
- ♦ 30th IEEE Symposium on Fusion Engineering (SOFE 2023), Oxford, United Kingdom, 9-13 July 2023; <https://sofe2023.co.uk/>
- ♦ 24th Joint Cryogenic Engineering Conference and International Cryogenic Materials conference (CEC/ICMC), Honolulu, Hawaii, 9-13 July 2023; <https://www.cec-icmc.org/2023/>
- ♦ 35th International Conference on Phenomena in Ionized Gases (ICPIG 2023), Netherlands, 09-14 July 2023; <https://www.icpig2023.com/home>
- ♦ 3rd Conference on Plasma Simulation (CPS), Raman Science Centre, Indian Institute of Astrophysics, Leh, Ladakh, 13-15 July 2023; <https://www.ipr.res.in/CPS/CPS-2022/index.html>
- ♦ 13th Nuclear Plant Instrumentation, Control & Human-Machine Interface Technologies (NPIC&HMIT 2023), Knoxville, Tennessee, USA, 15-20 July 2023; <https://www.ans.org/meetings/npic13psa2023/>
- ♦ 18th International Probabilistic Safety Assessment and Analysis (PSA 2023), Knoxville, TN, United States, 15-20 July 2023; <https://www.ans.org/meetings/psa23/>
- ♦ Summer school on plasma physics, intense lasers and nuclear fusion (IPFN Plasmasurf 2023), Lisbon, Portugal, 16-21 July 2023; <http://plasmasurf.tecnico.ulisboa.pt/>
- ♦ 60th Culham Plasma Physics Summer School, Abingdon, United Kingdom, 17-27 July 2023; <https://culhamsummerschool.org.uk/>
- ♦ 9th PSSI - Plasma Scholars Colloquium (PSC 2023), IIT Kanpur, 20-21 July 2023; <https://sites.google.com/view/PSC-2023>
- ♦ 23rd International Conference on Atomic Layer Deposition (ALD 2023) and 10th International Atomic Layer Etching Workshop (ALE 2023), Washington, 23-26 July 2023; <https://ald2023.avs.org/>
- ♦ IEEE Nuclear and Space Radiation Effects Conference (NSREC 2023), Kansas City, USA, 24-28 July 2023; <https://www.nsrec.com/>

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Know Your Colleague



Mr. Bhadresh R. Parghi joined IPR in 2011 in the SST-1 magnet group after completing his Diploma in Electronics & Communication from Nirma University, Ahmedabad. He further acquired his Degree in Electronics & Communication from Institution of Engineers, Kolkata in 2015. Currently, he is working in Magnet System Division as Scientific Assistant – D1. As part of his work, Bhadresh has mainly contributed in design, development, testing and periodic maintenance of signal conditioning electronic cards for various sensors of SST-1 Superconducting magnets as well as periodic maintenance and handling of large channel count magnet data acquisition system hardware & software. He also plays a major role in operation and troubleshooting of SST-1 magnets electronics subsystems during SST-1 plasma campaigns. He has also contributed to design and development of signal conditioning electronic cards for temperature and joint resistance measurement for High temperature superconductor based coils. He has experience in complete in-house PCB designing in two layer and four layer configuration up to layout stage. Currently, he is working on the design and development of microvolt measurement electronic cards for coils based on high temperature superconductor.

Plasma Exhibition @ ICFAI University Agartala (Tripura)



IPR Team with the faculty members and student volunteers from ICFAI University, Agartala

The IPR Newsletter Team

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