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The Four th State

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

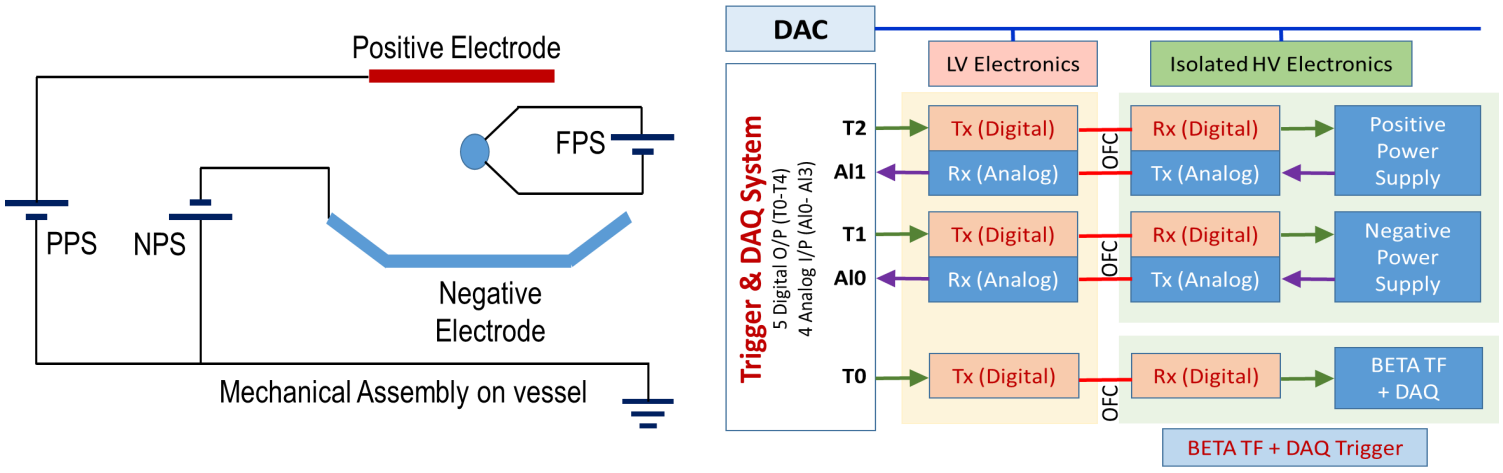
150 YEARS OF CELEBRATING THE MAHATMA

Electron Drift Injection System on BETA

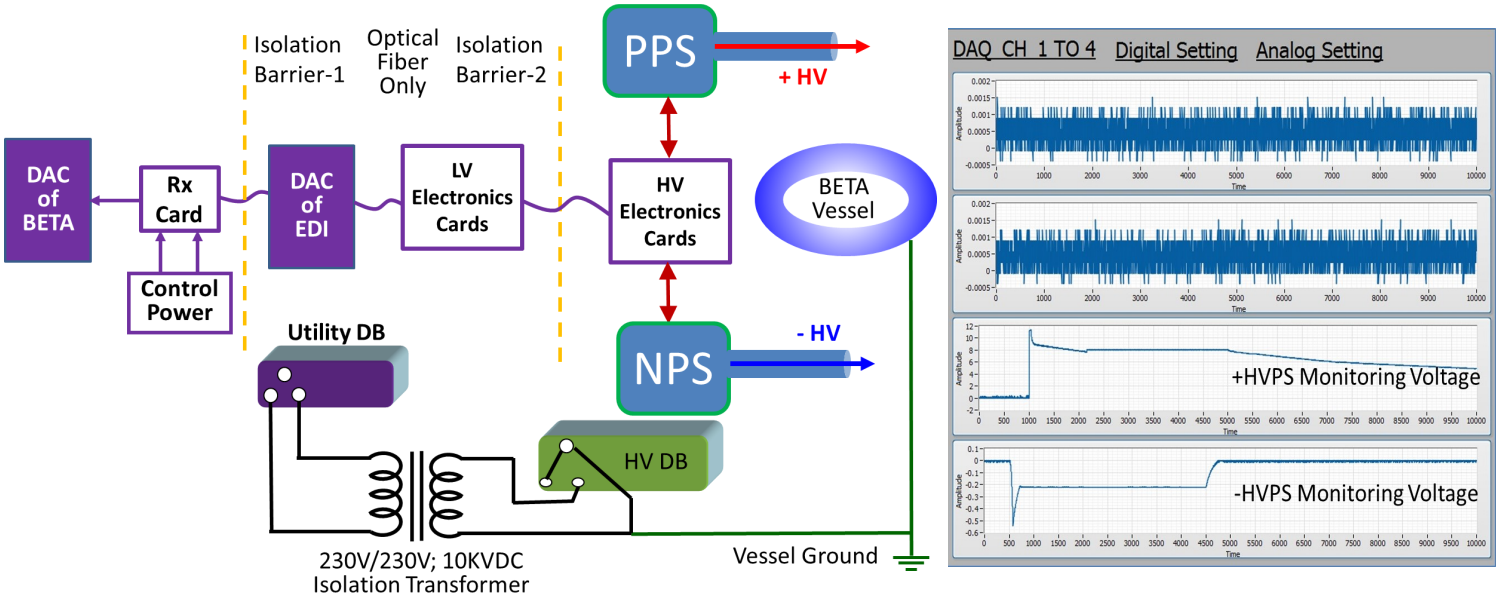
In a combined effort of SST-1 Operations Division, Magnetics and Dynamics Section, High Power ICRH Systems Division and BETA Section, an Electron Drift Injection (EDI) system has been commissioned on BETA.

An EDI system like any other pre-ionization schemes, improves plasma start-up phase by reduction of loop voltage required for the plasma breakdown. The electrons produced by filament, that generally cannot pass across the confining magnetic field, are driven across the magnetic field lines with the help of potential well, created by EDI system consisting electrodes with specific shapes.

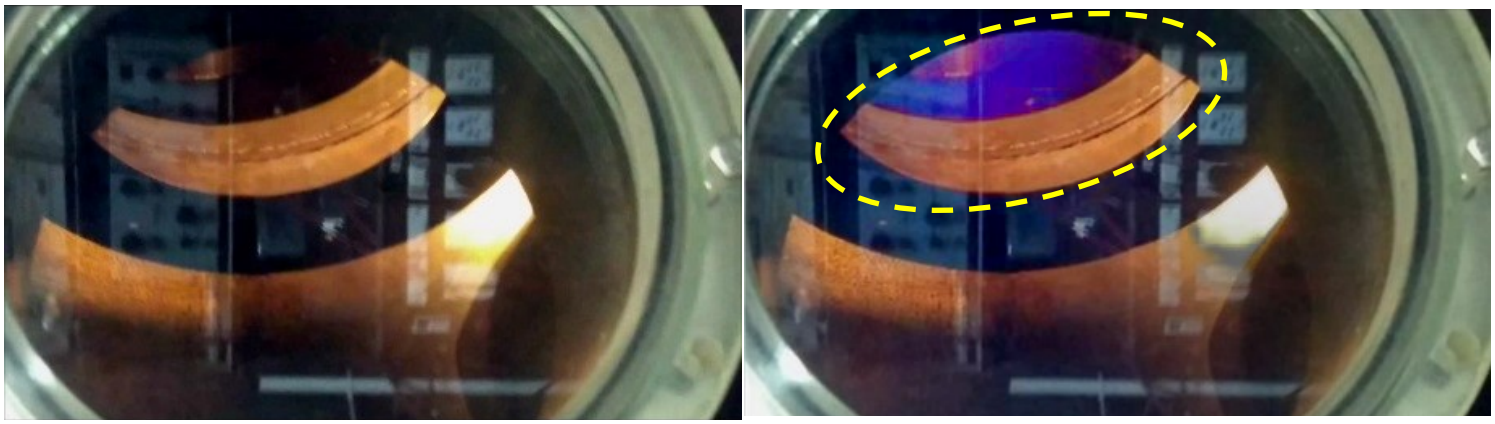
The EDI subsystems include two pulsed high voltage power supplies namely Positive Power Supply (PPS) 10kV,6mA, Negative Power Supply (NPS) -20kV,1.5mA, one filament supply (FPS) 300V,2A, analog and digital optical isolation circuits, data acquisition and control system to operate in synchronization with other subsystems of BETA machine.



(L) Schematic of the EDI system in BETA (R) Overview of the DAC system



(L) Image of the EDI system (R) DAC snapshot of the plasma shot #310 in BETA



View of the BETA (L) before plasma breakdown (R) During Plasma breakdown

(L) Commissioning tests (R) Integration tests being carried out on the BETA

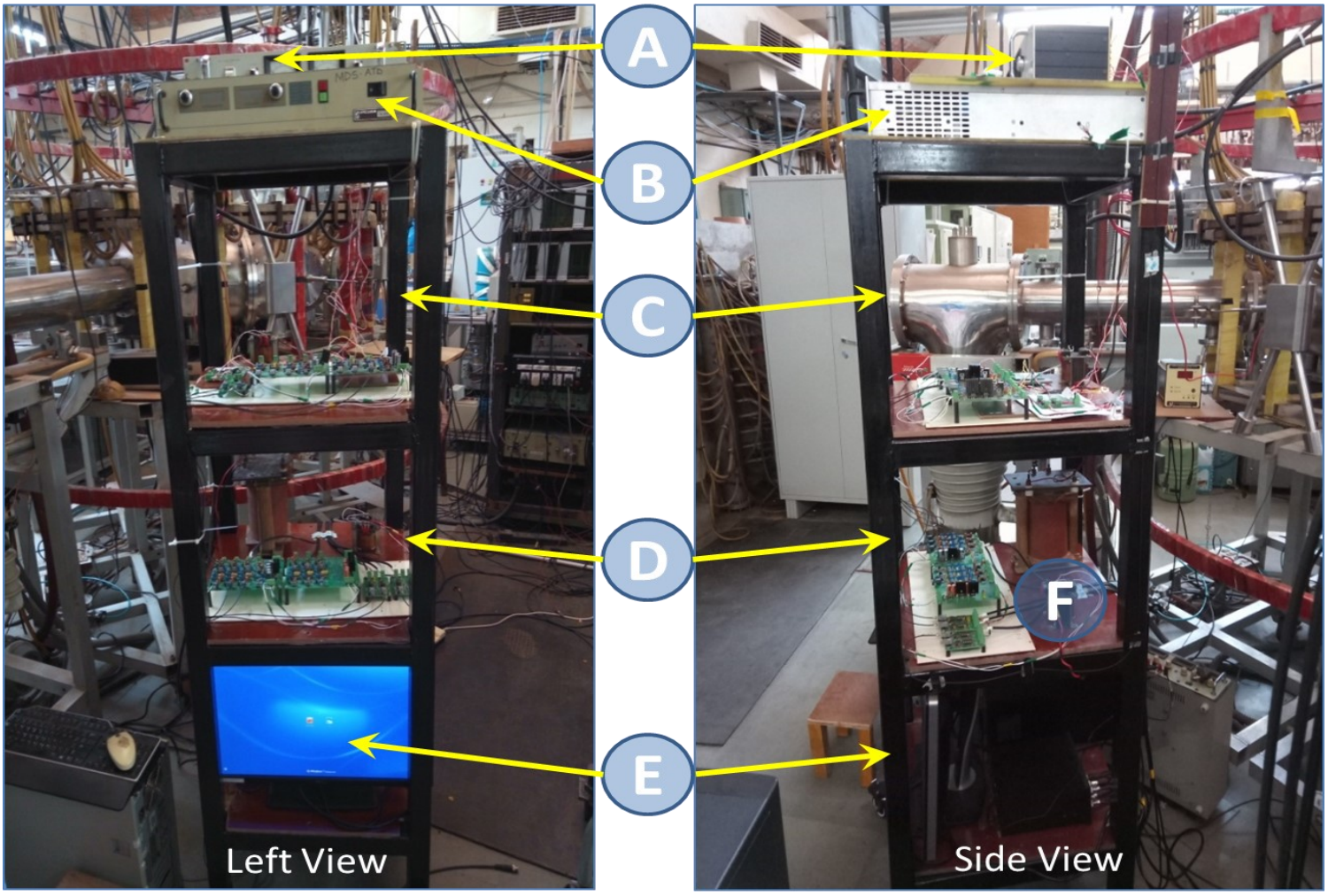
WHO Recommends The Following Simple Steps To

Follow Steps

Stay Safe

Wash your hands frequently with soap
Maintain social distancing
Avoid touching your eyes, nose and mouth
Practice respiratory hygiene
If you have fever, cough and difficulty in breathing, seek medical care early
Stay informed and follow advice given by your healthcare provider

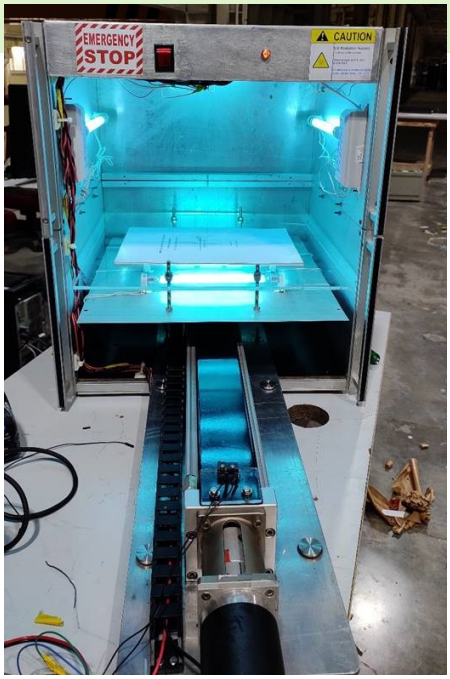
Download and use "Arogya Setu" app of the Government of India to fight the Covid-19 pandemic.



View of the EDI system (**A**) NPS (**B**) PPS (**C**) HV isolated cards (**D**) LV electronics cards (**E**) DAC (**F**) Isolation transformer

Automated & Contactless UV-C Disinfecting System

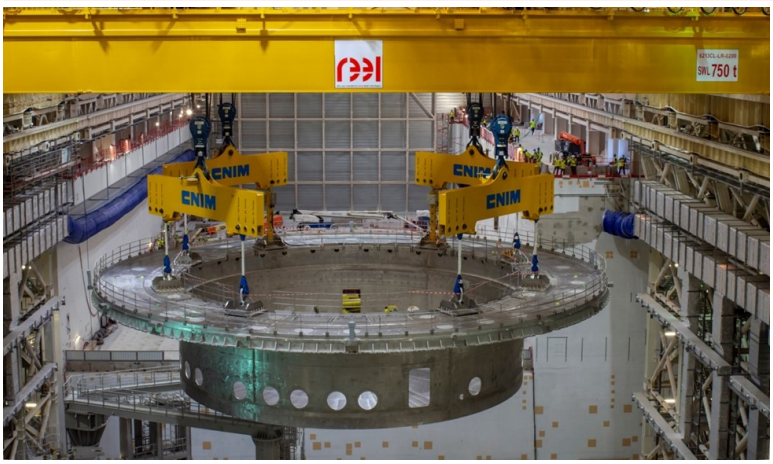
Remote Handling and Robotics Technology Development (RHRTD) Division has developed in-house, an automated UV-C disinfectant system for disinfecting any documents and materials. The system uses ultraviolet C rays to disinfect the items placed in it. UV-C rays are known to be effective disinfectants for pathogens like Covid-19. This system, developed by RHRTD, IPR with support from EID, IPR, uses a movable platform that is used to traverse the packages in and out of the sanitizing chamber. This ensures proper safety of the working personnel in the vicinity. The system is also pre-programmed to guarantee that the packages are kept inside the sanitizing chamber for the required exposure time, which is calculated based on available literature. The entire system can be used with just a click of a button! Since this system would be very useful for Dispatch section, Medical Section, Purchase and Accounts Sections as they receive many documents, files, etc. from outside sources, it has been installed in the Admin area for the use of Admin, Accounts and Purchase sections.



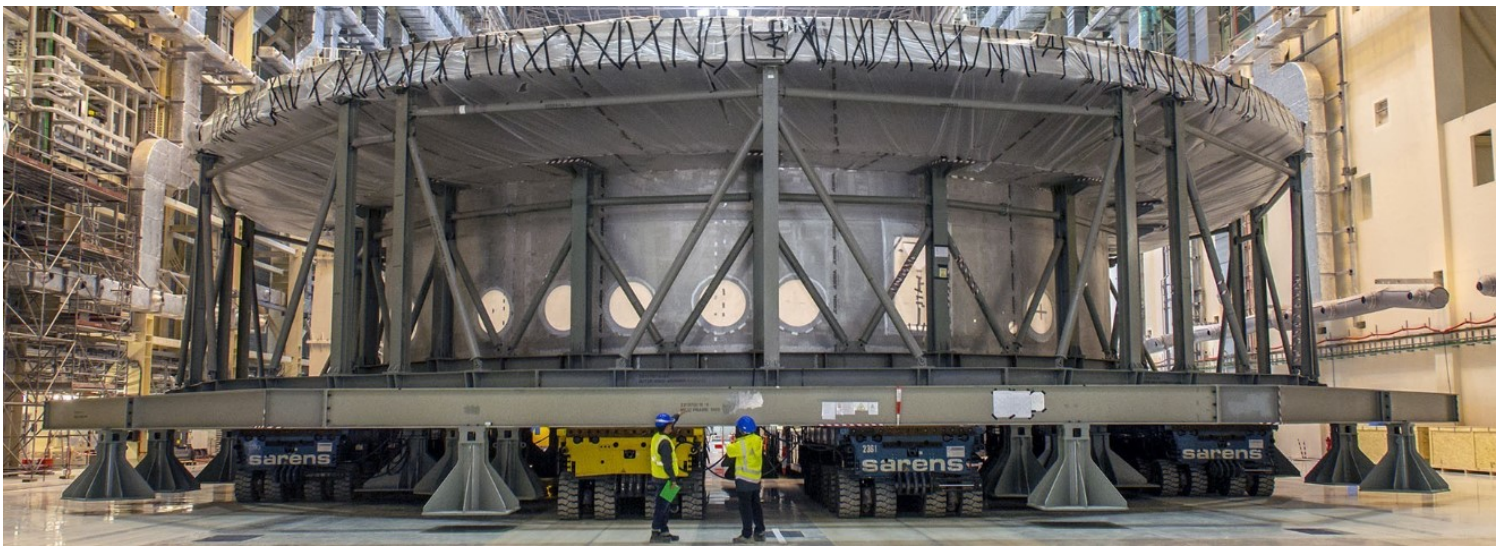
(L) The automated UV Disinfecting system (R) Installation of the system in the Admin Section (L-R) Jignesh Chauhan, Manoah Stephen, Ravi Ranjan Kumar, Naveen Rastogi, K.K. Gotewal, Niranjan Vaishnav and Anuj Harvey

Installation of Cryostat Base Section in ITER Tokamak - An Important Milestone

The Cryostat Base section, an in-kind contribution to ITER from India was installed in the ITER Tokamak pit during the wee hours of 28 May 2020. The structure weighing approximately 1250 Tons, with dimensions over 29 m diameter and 6 m tall was placed with positional accuracy of less than 3 mm with only very small gaps around. This feat was an important milestone in India's commitments to ITER and also marks the start of ITER Tokamak assembly.



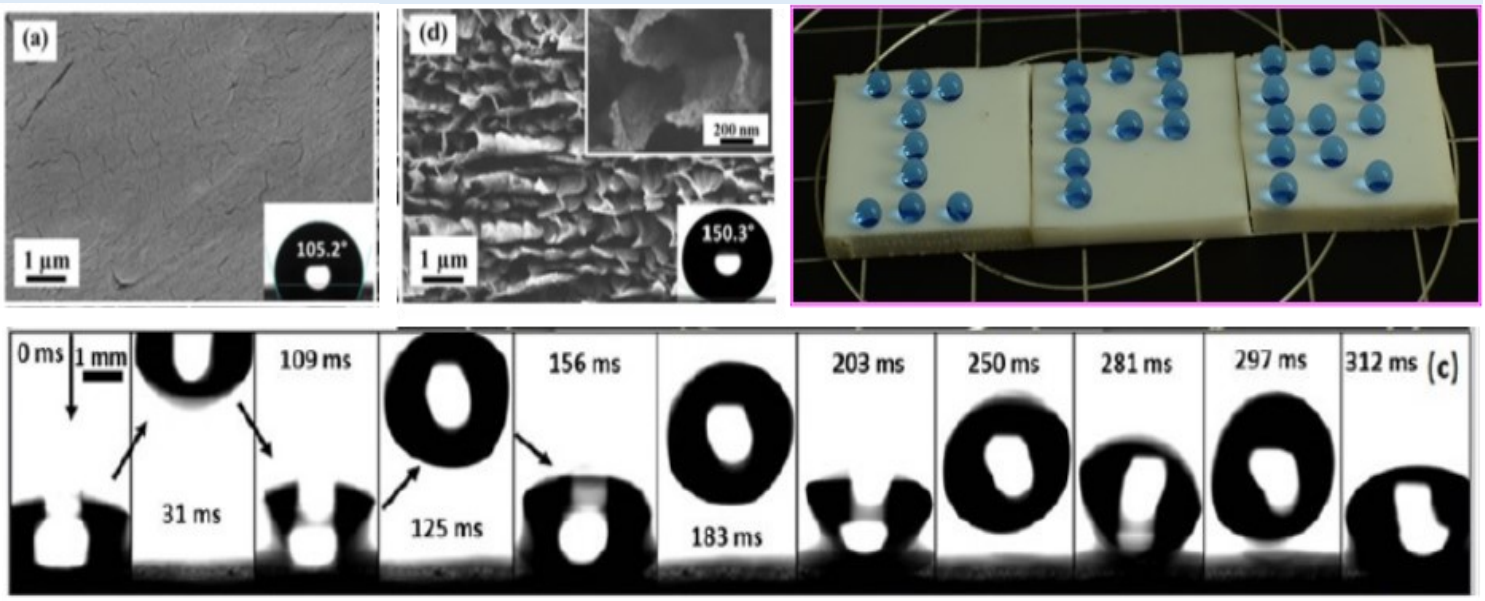
(L) Lifting Operation of Cryostat Base Section, ~1250 tons (R) Cryostat Base Section being lowered in the Tokamak pit



Cryostat Base Section positioned in the Tokamak Pit

Water Repellent Super-Hydrophobic PTFE Surface Produced by Ion Irradiation

Fabrication of hydrophobic and super-hydrophobic surfaces has extensively increased due to their superior water repellent properties. Further, development of functional surfaces with self-cleaning, anti-scratch, anti-icing, anti-corrosion and fog harvesting properties has turned out to be an emerging field of research with significant technological applications. Specially Teflon and Teflon like coatings find number of applications in automobiles, non-stick cookware, and medicine due to their useful properties such as high heat resistance, excellent electrical resistance, and biocompatibility. The study conducted at FCIPT/IPR it was attempted to modify the surfaces of Teflon substrates using low energy ion beam irradiation. It was observed that Teflon surfaces become super-hydrophobic when irradiated with a beam of low energy (300 - 800 eV) Ar+ ions for 10s of seconds. From a technological view point, this technique can be helpful in developing super-hydrophobic bulk Teflon sheets in very short time duration wherein a specific surface region can be made super-hydrophobic by using masking or ion beam writing.

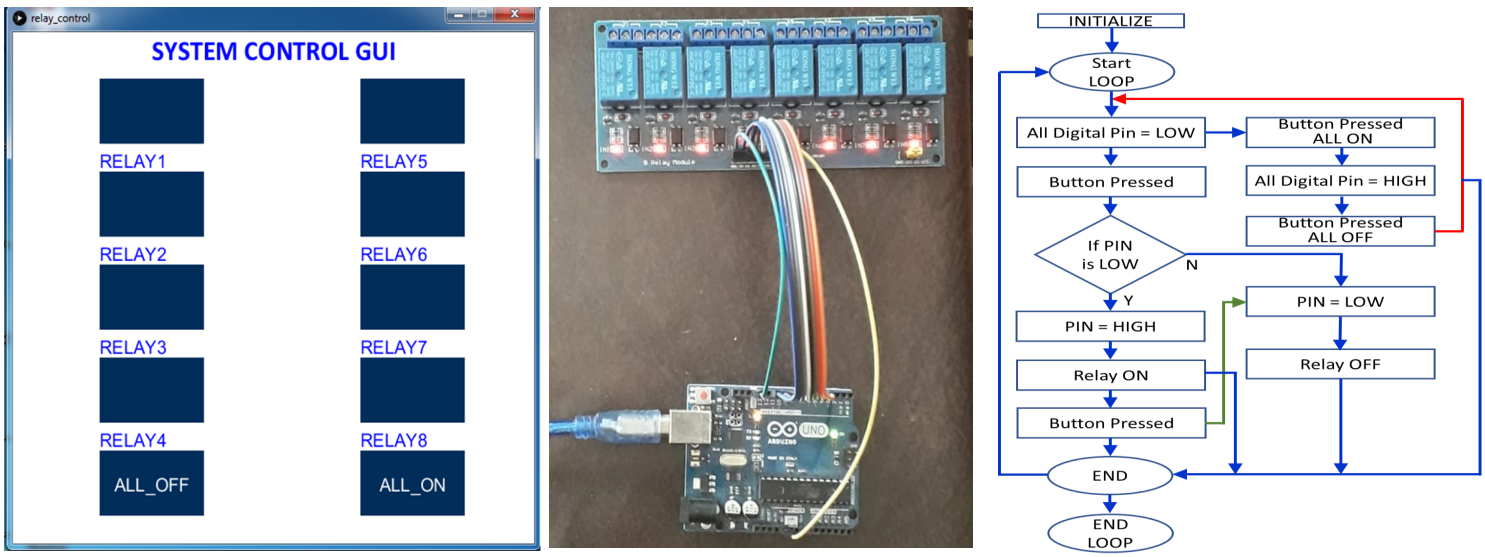


FESEM images of pristine and 800 eV ion beam treated Teflon surfaces at normal angle of incidence. High magnification images are shown in insets. Ion beam treatment time is 60 s. Photograph of spherical water droplets resting on super-hydrophobic Teflon surfaces and demonstration of bouncing effect of water droplet which is dispensed from 10 mm above the surface.

A Simple, Low Cost System Controller Using GUI

A simple low-cost computer-controlled Graphical User Interface (GUI) using an Arduino Uno microprocessor board and freely available software compiler has been developed in-house. The present module has been programmed for controlling up to eight (8) relays independently as well as simultaneously. During the operations, the status buttons of the GUI are updated in real time in order to make it more user friendly.

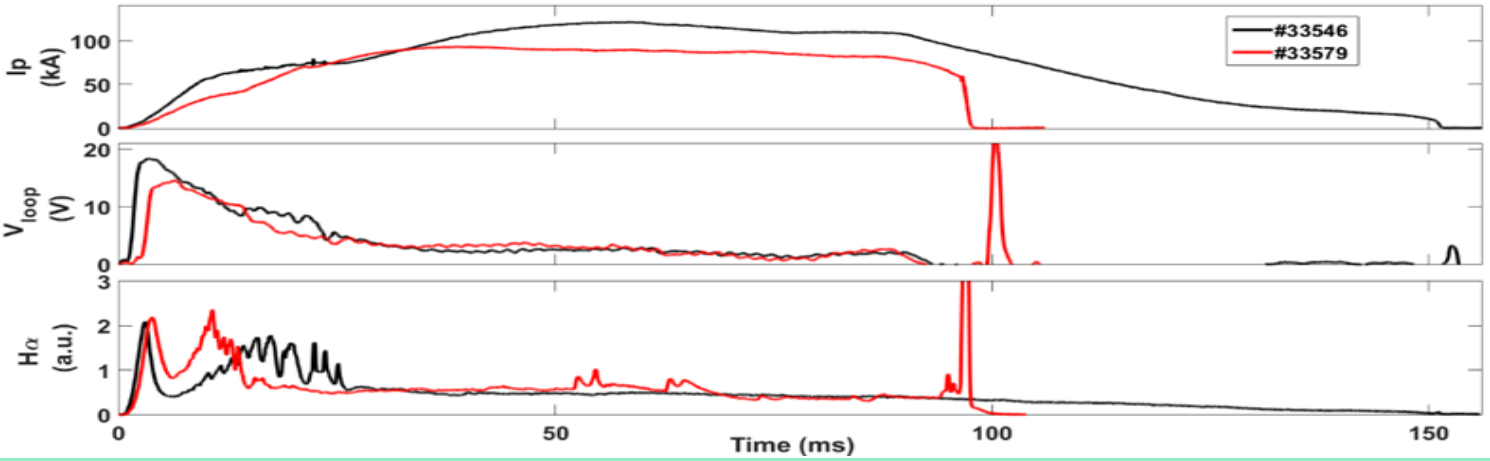
The developed GUI of the system can be compiled to an executable (.exe) file to be run independently on an appropriate platform. The present module is available for implementation to operate 8 numbers of electrical or electro-mechanical systems, power supplies, display systems, safety alarming systems, electro-pneumatic valves etc. This system can be easily upgraded to control 16 - 32 independent systems using the family of Arduino Mega and Duo boards.



(L) GUI of the system (M) The hardware (R) The flow chart of the process

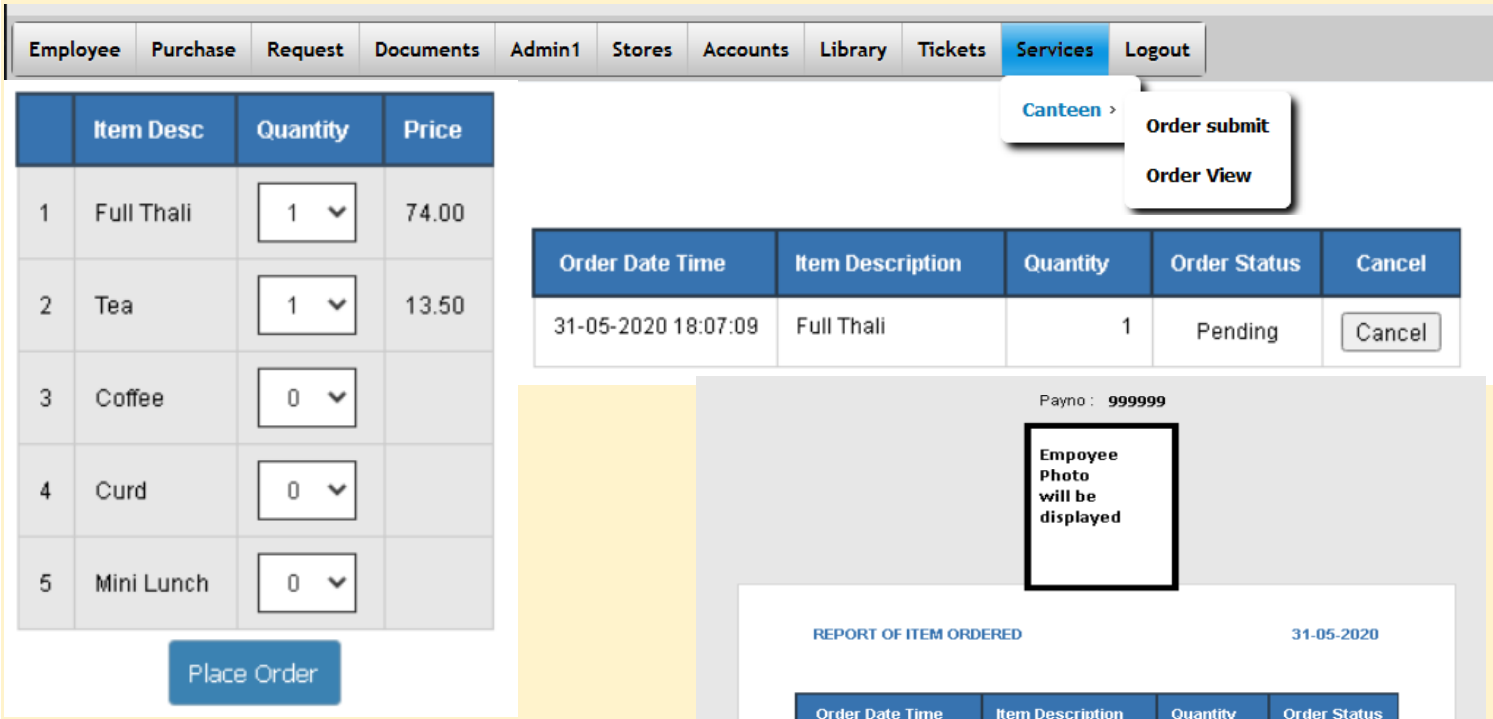
Aditya-U Resumes Operations

After almost ~ 3 months of shutdown due to COVID19 pandemic, ADITYA-U operations resumed using capacitor bank power supply (Ip ~ 30 kA, 20 ms) and from 11-June-2020, APPS operations were also started. With this, ADITYA-U is now fully functional. Standard plasma discharges of Ip ~ 120 kA and 150 ms (positive and auxiliary convertor only) has been obtained during this period. The real time horizontal plasma position control is in operation to stabilise the plasma column position in real time. A short baking cycle of vacuum vessel (~ 100 ^{0}C) for a day on Tuesday (16 June 2020) has been carried out in order to achieve better vacuum conditions in the vacuum vessel. The preliminary experiments using divertor coil is planned by discharging a capacitor bank through the main divertor coil. Recently the testing of capacitor bank generated current-pulse is carried out on dummy load. Around ~ 7 - 8 kA peak current for 25 ms duration is expected to be delivered through to the main divertor coils during plasma current flat-top. Due to the limitation of ~ 7 - 8 kA peak current in the divertor coil using the capacitor bank, which corresponds to ~ 42 – 48 kA-turn in main divertor coil, the peak plasma current has been purposefully brought down to ~ 80 kA and below for observing the effect of divertor current on the plasma column shape. The plasma current has been lowered down by lowering the loop voltage and by tuning other operating parameters. The low-current reference plasma discharges for preliminary divertor experiments are obtained. The two recent APPS discharges, one standard (Ip ~ 120 kA and 150 ms) and another low Ip (Ip ~ 80 kA, 100 ms), with APPS positive convertor operation only is shown in figure below. The effect of energising the divertor coils with capacitor bank on plasma column shape will be studied in coming days.



Contactless Ordering Facility @ IPR Canteen

Taking into consideration the social distancing norms due to the Covid-19 pandemic, and in order to maintain minimal crowding and contact at the canteen, IPR Computer Center has introduced a new canteen software, through which IPR staff can place order with the canteen for any item on the menu. Once the placed order is confirmed, all the staff needs to do is to go to the canteen and tell the canteen staff the payroll number of the staff and the order placed will be served to the staff. Staff can also cancel the placed order if they wish to do so, using this facility.



This facility will be accessible to staff through IPR, ITER-India as well as FCIPT networks, through their New E-office account from the IPR website. Billing will be done automatically as before. This module will work from desktop, laptop or mobile.

Patent for Negative Hydrogen Ion Technology for CPP-IPR

Recently, a patent for an invention entitled "*A Process For Production Of A Negative Hydrogen Ion And Apparatus Thereof* " has been granted to CPP-IPR for a full term of twenty years under the Patent No. 337942, for the work which had been carried out at CPP-IPR. An interesting aspect of this work is that it provides a process for production of negative hydrogen ions using cesium coated tungsten dust through surface production route. In this process, the negative hydrogen ions are coming out from the dust surface isotopically and fills the plasma volume, which overcomes the need of reversing the direction of negative ions for extraction in conventional negative hydrogen ion sources. The present source will help in developing a compact efficient ion source in future. This is the first patent that CPP-IPR is obtaining for technology developed at CPP-IPR. The scientists involved with this novel work were B. Kakati, S.S. Kausik and B.K. Saikia from CPP-IPR & M. Bandyopadhyay and late Prof. P.K. Kaw from IPR, Gandhinagar. The work was supported by the Department of Atomic Energy, Govt. of India.

The negative hydrogen ion setup for which the patent was granted to CPP-IPR

Annular Solar Eclipse of 21-June-2020

An annular solar eclipse was visible over many parts of India on 21-June-2020. Over Ahmedabad, the eclipse was partial with a maximum of around 70% of the sun being eclipsed by the moon.

(L) The eclipse event playing hide and seek with the clouds (M) Close to the maxima (R) The finishing stages

Past Events @ IPR

- ***Dr. Shashi Kant Verma,*** Institute for Plasma Research, Gandhinagar, gave a talk on "*Development of CFD model for the analysis of a Cryogenics Twin-Screw H2 Extruder System*" on 20th March 2020
- ***Dr. Mukesh Ranjan,*** Institute for Plasma Research, Gandhinagar, gave a webinar on "Plasma and its Industrial Application" at a webinar "*Prospective of Interdisciplinary Research in Science and Technology in the Present Scenario*" organized by Department of Physics, Ch. Charan Singh University, Meerut, UP, on 16th May 2020
- ***Mr. Chirag Sedani,*** Institute for Plasma Research, Gandhinagar, gave a webinar on "*Nuclear Science & Technology*" organized by Mechanical Engineering Department, R. N. G. Patel Institute of Technology, Bardoli. Surat, on 26th May 2020
- ***Dr. Shashikant Verma,*** Institute for Plasma Research, Gandhinagar, gave a webinar on "*Introduction to CFD and career opportunities in CFD for UG Students*" organized by Bharati Vidyapeeth's College of Engineering, Pune, on 26th May 2020
- ***Mr. Ravi Pandey,*** Institute for Plasma Research, Gandhinagar, gave a talk on "*Design and Analysis of TWIN source extraction system (grids) with feasibility assessment on indigenous manufacturing*" on 3rd June 2020
- ***Dr. S. Sunil*** of LIGO-India Division gave a webinar entitled *"An Introduction To LIGO: Challenges and Opportunities"* for students of Sathyabama Institute of Science and Technology, Chennai on 3-June-2020.
- ***Mr. Pranjal Singh,*** Institute for Plasma Research, Gandhinagar, gave a talk on "*Study of In Situ Measurement of Work Function and Cesium Dynamics*" on 9th June 2020
- ***Dr. Arkaprava Das,*** FCIPT, IPR, Gandhinagar, gave a talk on "*Nanoparticle synthesis by thermal plasma in liquid and gaseous medium*" on 11th June 2020
- ***Ms. Ranjana Gangradey,*** Institute for Plasma Research, Gandhinagar, gave a talk on "*Pumping speed of Hydrogen and Helium gases using activated carbons as sorbent material at liquid helium temperature for cryopump applications*" on 16th June 2020
- ***Mr. Manoah Stephen M,*** Institute for Plasma Research, Gandhinagar, gave a talk on "*Design and Development of Gravity Compensated Remote Handling Arm*" on 16th June 2020
- ***Mr. Saroj Das*** gave a webinar on *"Crafting an Impactful Job Interview: What and What Not"* organized by the School of Library and Information Science, Central University of Gujarat, Gandhinagar, on 17 June 2020.
- ***Mr. Mandeep Singh,*** Nanatom Technologies, Bengaluru, gave a talk on "*Introduction to Nanatom's Multirole Multiscale Material Characterization Solutions*" on 19th June 2020
- ***Ms. Janki Shah,*** Institute for Plasma Research, Gandhinagar, gave a talk on "*Hydrophobic Silica Nanofluid and its Applications*" on 19th June 2020
- ***Mr. Venkata Nagaraju Muvvala,*** ITER-India, Institute for Plasma Research, Gandhinagar, gave a talk on "Study *of Hypervapotron Cooling Phenomena Using CFD and Experiments for Neutral Beam Loading Scenarios*" on 23rd June 2020

Upcoming Events

- 7th International Conference on Microelectronics, Circuits & Systems, Delhi Technological University, Delhi, 25-26 July 2020 https://actsoft.org/micro2020/

Know Your Colleague

Mr. Kiran Patel joined IPR in 2003 as a Technical Assistant with the Laser Diagnostic section and subsequently was promoted to Scientific Officer – D. During his tenure at IPR, he acquired B.E. (Electronics & Communication) from Gujarat University and M.E. (Signal Processing and VLSI Technology) from Gujarat Technological University (GTU). His area of work for Laser Diagnostic is Data Acquisition and Control Electronics, FPGA & Controller based system design and LabVIEW based Instrumentation control and DAQ.

He had designed and developed fast gated integrator based data acquisition (DAQ) system for SST-1 Thomson Scattering Diagnostic. He had also developed neutral pressure measurement diagnostic using ASDEX pressure gauge on ADITYA-U Tokamak. He was deputed to work at CEA Cadarache, France from June to December, 2016 and Developed I&C and DAQ system for Visible Spectroscopy Diagnostic.

He actively participates during National Science Day and other events organized / managed by the institute.

The IPR Newsletter Team

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