वार्षिक प्रतिवेदन
2022-2023

ANNUAL REPORT
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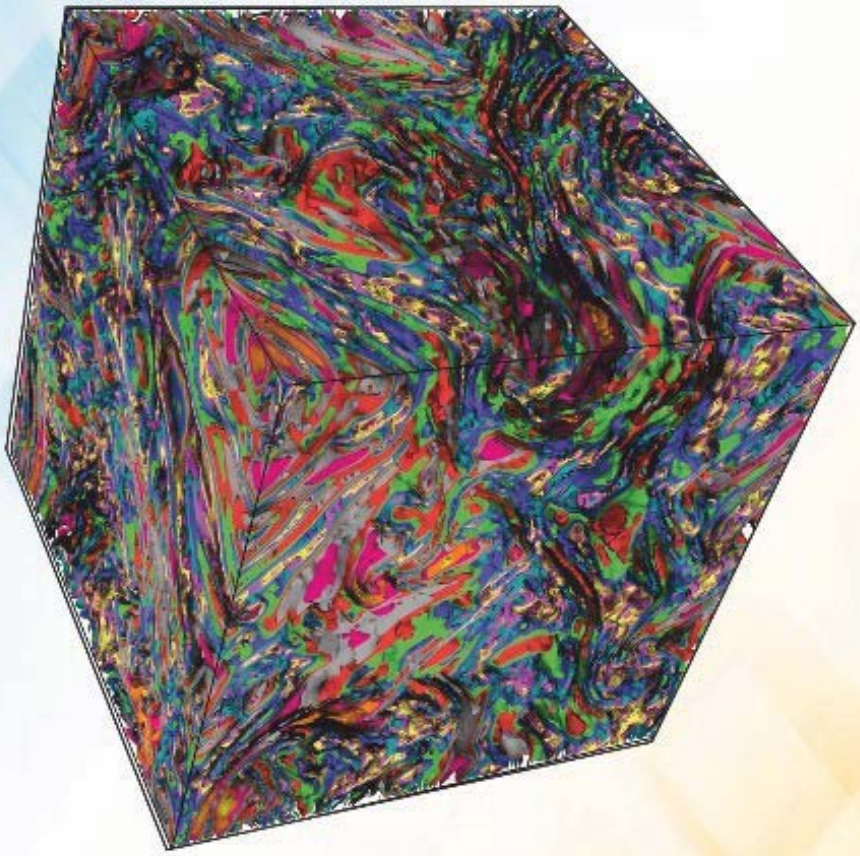
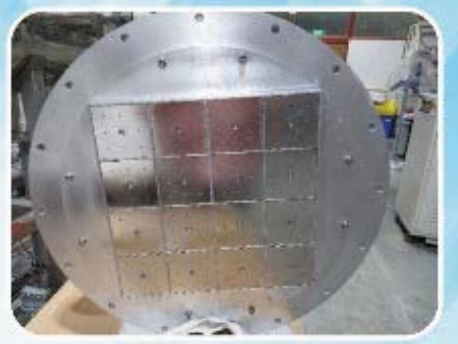


प्लाज़्मा अनुसंधान संस्थान
Institute for Plasma Research

भाट, निकट इन्दिरा पुल, गांधीनगर - 382 428, (गुजरात), भारत
Bhat, Near Indira Bridge, Gandhinagar 382 428, (Gujarat), India

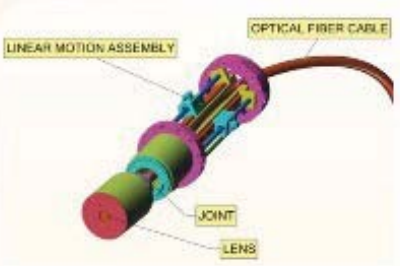
माइक्रोवेव द्वारा उत्पादित प्लाज़्मा स्टरलाइज़ेशन प्रणाली

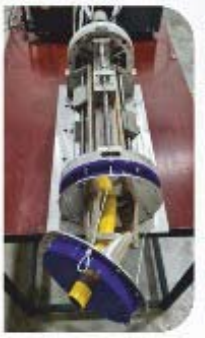
Microwave produced plasma Sterilization system



संस्थान में विकसित लार्ज एरिया प्लाज़्मा स्त्रोत

In-house developed Large Area Plasma Source





लेंस बंडल को संचालित करने के लिए मैनिपुलेटर का प्रोटोटाइप

Prototype manipulator for maneuvering the lens bundle

सुपरसोनिक प्लाज़्मा प्लम

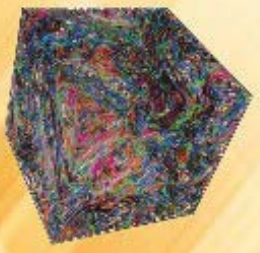
Supersonic plasma plume

अगस्त्य - 400 : देश में विकसित क्रायोसॉर्प्शन क्रायोपम्प

AGASTYA-400: Indigenously developed Cryosorption Cryopump

अति उच्च वोल्टेज स्पटरिंग प्रणाली

UHV sputtering system



On the cover page :

संस्थान में विकसित GPU-आधारित कोड का प्रयोग करके हेलिकल डायनेमो द्वारा संचालित क्रिया द्वारा प्राप्त किए गए लघु-स्तरीय चुंबकीय आइसो-सतहें

Short-scale magnetic iso-surfaces driven by helical dynamo action obtained using an in-house developed GPU-based code

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प्लाज़्मा अनुसंधान संस्थान

Institute for **Plasma Research**

Bhat, Gandhinagar 382428

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EXECUTIVE SUMMARY

The institute continued its quest towards indigenization with a variety of systems, technologies or knowhow either developed in-house, or in collaboration with various centers of excellence within India, the various units of DAE and Indian industries. The major thrust areas include a) Societal applications of plasma based technologies b) Fusion machines and technologies c) High performance computing d) Experiments and theoretical aspects of fundamental plasma physics. Onsite integration and timely delivery of components to the ITER Site made good progress, as well as the creation of world-class in-house test facilities..

Significant progress in the area of plasma based technologies and applications has been achieved this year. The developments include i) a compact, easy-to-handle DC plasma based system to enable sterilization of medical equipment and tools ii) a low energy ion beam facility to produce nano-ripple pattern surfaces for growing metal nanoparticle arrays used for detecting various hazardous dyes used in spices, fruits, vegetables, etc. iii) a low pressure oxygen plasma treatment method to achieve more than 99% reduction in bacterial adhesion and biofilm formation on catheter surface iv) a system for formation of functionalized coatings at very low pressures using a thermal plasma torch v) plasma treatment of seeds for enhancing germination, decontamination, degradation of pesticide residue etc. vi) a technology to produce Plasma Activated Water to reduce microbial load during cleaning of milk containers vii) Plasma Thruster Technology viii) plasma fireball-mediated ion implantation for nonvolatile memory application ix) High Power Impulse Magnetron Sputtering System (HPIMS) x) resistive arm based planar and conformal meta-surfaces for Radar Cross Section (RCS) reduction xi) development of magnetically strong α-MoO_3 nanomaterials. Many of these developments enabled execution of technology transfer agreements with Indian industries. Satellite Solar Panel testing was conducted for a Space sector Startup, using facilities existing at the institute.

In the area of high performance computing (HPC), the 1 Petaflop ANTYA HPC achieved an uptime of 99.7%. Almost 50,000 HPC jobs were completed successfully by the community of HPC users. Examples of significant studies include simulations of electromagnet launcher system employing double-sided linear induction motor, wettability gradient driven automatic movement of liquid droplet on a surface, coupling of laser energy to cluster electrons without any external injection and ion driven destabilisation of a toroidal electron plasma. A Container-based Data Centre, incorporating rack-based server cooling & UPS, with a total IT capacity of 100 kW, has been set up – possibly the first such installation in a Govt. of India establishment. The process of upgradation of ANTYA is also underway, especially with regard to AI/ML capability.

Progress continues on the ADITYA-U and SST-1 experimental tokamaks. In ADITYA-U, Standard reproducible discharges of Plasma current (IP) ~ 100 kA, for discharge durations of ~300 ms at a toroidal magnetic field of ~1.2 T were achieved. Several new diagnostics coupled with the existing ones have enabled understanding of physical phenomenon such as nature of turbulence, radial structure of zonal flows, effect of gas puff and Supersonic Molecular Beam Injection (SMBI) on edge parameters and their fluctuations, observation of tearing modes, temporal evolution of hard X-ray spectra, pitch angle scattering events and spatial mapping of low pressure cluster jets. A dust injector has been installed to enable boronisation and allow studies related to impurity-induced turbulence suppression and transport. Studies related to Argon impurity transport in ADITYA-U have been carried out to study the role of Argon in radiative power dissipation by reducing heat load on divertor plates and allow for fine control and compatibility with plasma confinements. Geodesic Acoustic Modes (GAM) have been observed for the first time in any tokamak and could be the result of the magneto-hydro-dynamics (MHD) oscillations. In addition, studies related to understanding the role of the

MHD activity in sawtooth induced heat pulse propagation have been performed. In SST-1, plasma current of 65 kA for the duration of 650 ms with density 8 x 10^{12} cm^{-3} and temperature 250 eV has been demonstrated. In order to enhance the plasma density & temperature, attempts are underway for the injection of Inductively-driven Pellets of Micro-granules of Lithium Titanate powder. In addition, hardware integration to enable in loop Plasma Control System (PCS) is under way. This also includes development of a simulation model for vertical field power supply to generate the required coil current profile based on expected plasma current profile and linear plasma simulation model to model plasma breakdown, current startup and its evolution based on previous experimental observations. To improve the diagnostic access to the plasma and enable installation of in-vessel coils to provide long duration controlled plasma, some of the Plasma Facing Components (PFCs) were removed. A new high power 1.5 MW, 36-65 MHz ICRH system has also been successfully integrated with SST-1.

Experimental and theoretical work continues to progress steadily in various areas of fundamental plasma physics. Experiments on the dusty plasma experiment device have shown self-sustained non equilibrium co-existence of the fluid and solid state in a strongly coupled complex plasma system for the first time. Experiments conducted in an inverted Π-shaped dusty plasma experimental device helped to understand the effects of the fore-wake structures excited in between two charged objects in a flowing dusty plasma. Upgrades on several devices like the Large Volume Plasma Device (LVPD), non-neutral plasma device (SMARTEX-C) and Basic Experimental Toroidal Assembly (BETA) have been completed and the devices have been recommissioned for further experimentation. APPEL device has been recently commissioned to enable studies related to plasma confinement in linear, mirror and end cusp configuration. Further the device can be helpful in underpinning the source of deleterious effects during magnetized plasma surface interaction with a material body, which occurs at the Scrape Of Layer (SOL) of the fusion device and Ion Cyclotron Radio Frequency (ICRF) antenna surfaces exposed to magnetized plasma. Implementation of cusp magnetic fields on the Inertial Electrostatic Confinement Fusion (IECF) device have shown the neutron production rates to double. Experiments on the System for Microwave Plasma Experiment (SYMPLE) device have helped to validate theoretical prediction of fractional absorption of microwaves in plasma. Experimental observations related to the increase in atomic nitrogen concentration in the presence of external magnetic fields on the Helicon Plasma Source (HeLIPS) device could be useful for application in the areas of semiconductor etching, surface modifications, nitride film deposition etc. In addtion extensive theoretical and simulation work has been performed in several areas related to non linear plasmas, tokamak and fusion reactor studies, fundamental plasma studies, laser plasma interactions and dusty and complex plasmas.

Significant progress was made in the area of fusion technologies towards Atmanirbharta. Two major achievements were the commissioning of an accelerator-based 14 MeV D-T neutron facility capable of generating 5x10^{12} neutrons per second, and an Experimental High Pressure Helium Cooling Loop, both of which were inaugurated by Chairman AEC. Magnet technologies developed this year include indigenous development of Cable-in-Conduit Conductor using low-temperature superconductor, which was done in associated with AFD BARC, a 1 Tesla conduction cooled magnet, and a 1 m long 3 kA rated high temperature superconducting cable. Fusion blanket technologies include interesting results from operation of the liquid Pb-Li MHD loop, measurement of sonic velocity in Pb-Li at high temperature, development and testing of atmospheric molecular and cryogenic molecular sieve beds and knowledge of hydrogen isotope mass transport parameter in Pb-Li and development of hydrogen isotope extraction system. Cryotechnologies include indigenously developed liquid nitrogen cooled sorption cryopump for SST-1, AGASTYA-400 for space applications and high pressure helium circulators. A Remote handling system is at an advanced stage of development for manipulation of an imaging fiber bundle handling in hot cell. Negative ion neutral beam technologies related to achieving ~2A H-

beams on ROBIN, development of multi aperture grid system using brazing technique, large diameter 90 kV post insulators, 1 mm thick Molybdenum coating using laser additive manufacturing and development of large area copper electrodeposition on copper base material applicable to large area grids in fusion environment. For the first time, institute has obtained stable operation of the complete positive ion neutral beam system, including the cryo-system with 4 cryopumps and helium plant; the ion source upto 36 kV, reliably extracting a 30 A beam.

ITER-India continues its steady progress towards fulfilling its commitments to ITER in a timely manner and adhering to the desired safety and quality norms in line with French regulatory requirements. In addition to the above task agreements with ITER have enabled additional developments which include the Torus cryopump housing system, safety important hydrogen mitigation system vessels and the vacuum vessel for the 3rd heating and neutral beam injector system. Several sub-assemblies of the torus cryopump housing several subassemblies have been fabricated. The vessels related to hydrogen mitigation systems has been manufactured and accepted by the ITER organisation. Installation work of 60-70% of the supplied cryolines has been completed at the ITER site. The factory acceptance tests of the beam line components for DNB have been completed. The 170 GHz 1 MW 1000 s gyrotron source has been tested to its full performance at the gyrotron test bed in the ITER India laboratory.

DIRECTOR,
IPR.

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Considering fusion as an alternative source of energy, the Institute had initiated a programme to study magnetically confined high temperature plasmas in 1984 and built India's first tokamak ADITYA in 1989. Nearly a decade later a steady state tokamak, SST-1 using superconducting magnets is also constructed. Since the inception, the institute has been involved not only on fusion plasma R&D activities but also various plasma physics related fundamental research and its technology developments to address many industrial and societal challenges. To meet large scale computer based design and analysis requirements a High Performance Computing (HPC) facility has also been established capable of handling 100kW of IT load. Over these years, the institute has trained a large number of man power to pave the way to reach India's "self-reliant/Atmanirbhar" goal in the field of plasma science, technology and fusion power. Institute is involved in two international mega science projects, ITER and LIGO; where highly advanced state-of-the-art devices/components to be delivered as in-kind contributions. Many of such technologically challenging items are already delivered successfully. Institute is internationally recognized for its contributions to fundamental as well as applied research in plasma physics and associated technologies.

CHAPTERS

CHAPTER A

SUMMARY OF SCIENTIFIC & TECHNICAL PROGRAMMES

A.1 Plasma Based Technologies & Applications

Plasma based technologies and applications is a key area with far reaching technological and societal benefits. New projects in these areas continue to be added while good progress continues. The highlights of this year are detailed in the following subsections

A.1.1 Plasma Surface Engineering Applications

Development of plasma system for sterilization of medical equipment and baby utensils: A new, compact, easy-to-handle DC plasma (Fig. A.1.1) based system has been developed for sterilization of medical equipment and tools. In another development, a microwave based plasma source has been used for trials and has yielded significant reduction in time scales (almost a factor of 10) for achieving 6-log reduction in the colony forming units of micro-organisms, the norm for sterilization.

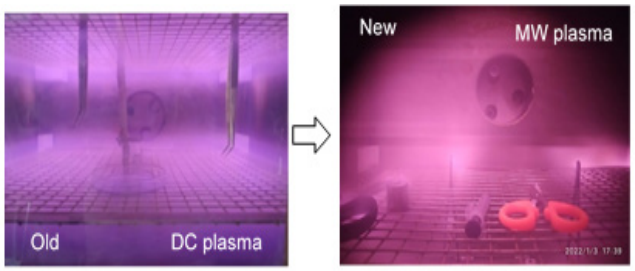

Figure A.1.1: Plasma inside the sterilization system: comparison between DC (left) and microwave (right) produced plasma.

Preliminary plasma-bio trials have also been conducted that have revealed the effect of plasma on the cell wall / membrane and genetic material. Development of a compact microwave plasma sterilization system and submission of patent are the next steps.

Surface Enhanced Raman Scattering (SERS) based detection of various molecules: Noble metal nanoparticle based Surface Enhanced Raman Scattering (SERS) spectroscopy is a powerful technique for the detection of molecules under very low concentrations. Normally characteristic vibrational modes of the molecule are undetectable by Raman Spectra but in presence of metal nanoparticles, 20-30 nm they are more intensely excited and clearly resolved. This is possible because the metal nanoparticle arrays produce enhanced electromagnetic field between the nanoparticles. A molecule present in this region (hot-spot) will experience enhanced field which leads to higher Raman scattering signal. Gold (Au) and Silver (Ag) are commonly used for most of the SERS based detection studies. At the institute, we have developed a low energy ion beam facility to produce nano-ripple pattern surfaces which are used as templates for growing metal nanoparticles arrays. These act as a substrate for SERS based detection of various molecules. The optimization of ripple pattern formation on silicon substrate was carried out, by varying ion

energy, flux and fluence. This was followed by Ag nanoparticle deposition on the patterned substrate. AFM image of ion beam produced ripple pattern and FESEM image of silver nanoparticle on the patterned Si are shown in figure A.1.2.

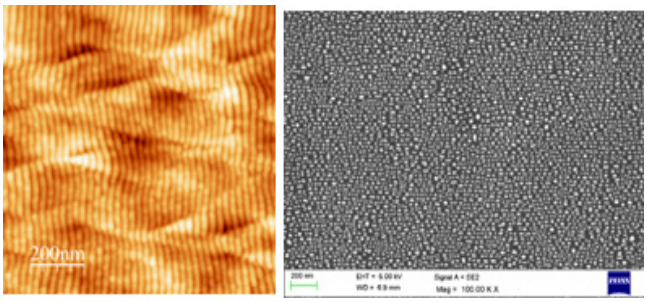

Figure A.1.2: AFM image (Left) of ripple pattern on Si, FESEM image (Right) of Ag nanoparticle arrays grown on pattern substrate.

The developed SERS substrates are used for the detection of various hazardous dyes used in spices, fruits, vegetables, etc. The SERS spectra of Erythrosine B and Rhodamine B under various diluted concentration are given in figure A.1.3.

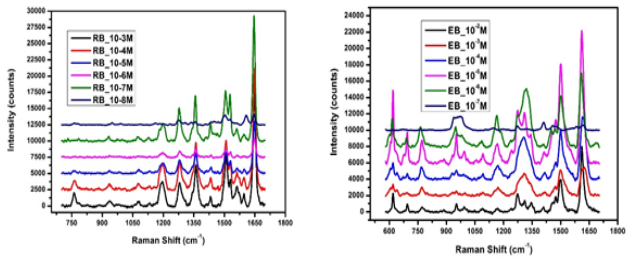

Figure A.1.3: (Left) SERS spectra of Rhodamine, (Right) B SERS spectra of Erythrosine B.

As part of the project, the developed SERS substrates were commercialized by signing a contract agreement with Indian industries. A patent application titled "Method of making nano-patterns on soda-lime glass followed by Ag nanoparticles growth for SERS sensor" is also filed through DAE as part of the project.

Plasma surface modification of silicone catheter surfaces for reduction of bacterial adhesion: Bacteria often try to attach to catheter surfaces and form a complex three-dimensional structure known as biofilm. In our study, we have found that low pressure oxygen plasma treatment is able to reduce bacterial adhesion and biofilm formation on catheter surface significantly (≥ 99 % reduction) without the use of antibiotics / other complex coating and remains efficient up to 30 days after plasma treatment when stored under ambient conditions. Figure A.1.4, shows biofilm growth on untreated catheter surface (a) whereas all other images (b – f) show bacterial adhesion on plasma treated catheter surface in which we can observe different phenotype changes in adhered bacterial cells including elongation and death of the cell.

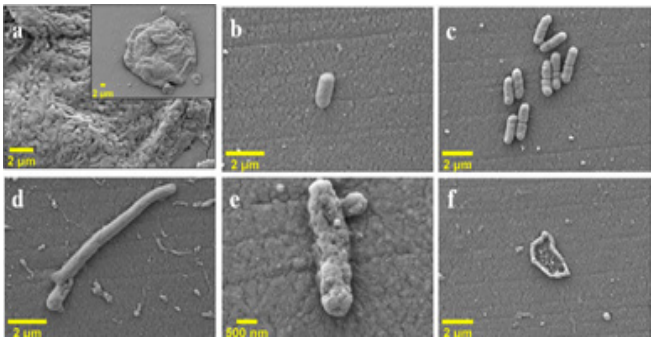

Figure A.1.4: SEM image of silicon catheter surfaces before and after plasma modification.

A.1.2 Atmospheric Plasma Applications

Testing of 100kW Graphite electrode based plasma torch system for 120 hours: Institute is developing a 5 Tonnes/day plasma-pyrolysis based biomedical waste disposal plant for deployment at the Homi Bhabha Cancer Hospital, Varanasi using three 100

kilowatt graphite-electrode based plasma arcs (Fig. A.1.5). In a major milestone, these arcs and associated power supplies have been tested continuously for 120 hours.

Figure A.1.5: 100kW plasma arc system.

The investigation of thermal plasma torch plume at very low pressure (~ 1 – 10 mbar) has yielded interesting results. The spectral signatures show the transition of the plasma plume from subsonic to supersonic regime. The supersonic plume has been characterized using a combination of fast imaging and spectroscopic diagnostics and the operating parameter regime most suitable for spray experiments identified.

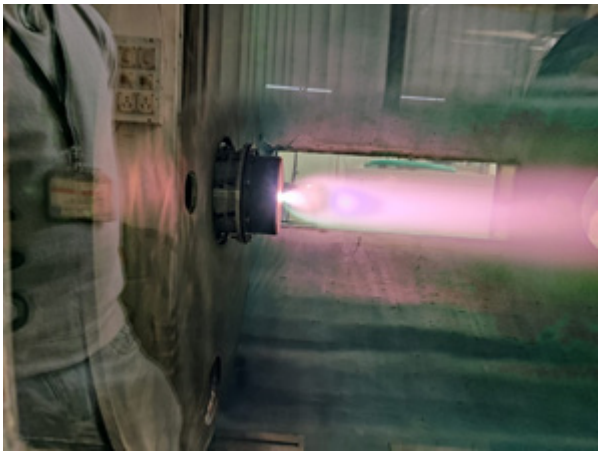

Figure A.1.6: Supersonic plasma plume.

A very low pressure plasma spray system (VLPPS) for forming functionalized coatings has been set up and preliminary experiments with sample powder have been performed. This system has been developed for formation of functionalized coatings at very low pressures using a thermal plasma torch. The technique aims to combine the advantages of physical vapor deposition and atmospheric plasma spray. The supersonic plasma plume (Fig. A.1.6) has been characterized and the system is ready for spray experiments. Preliminary spray experiments and coatings characterization has been carried out.

Development of large area atmospheric pressure air plasma system for seed treatment: Plasma treatments are currently being studied as a seed processing technology for agricultural applications.

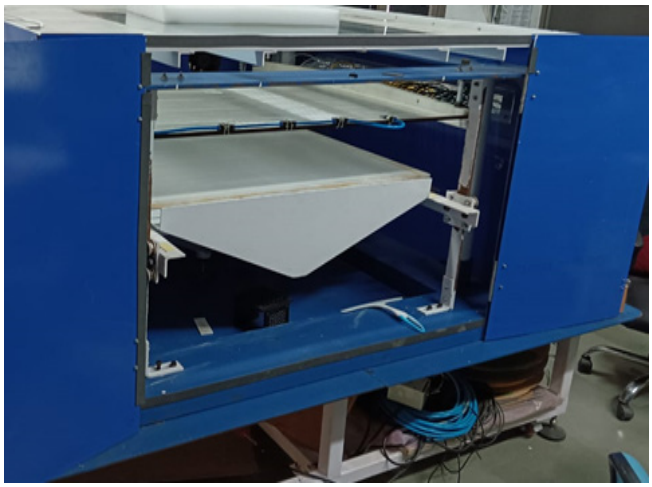

Figure A.1.7: Atmospheric pressure plasma system for seed treatment.

The plasma treatment of seeds is used for enhancing germination, decontamination, degradation of pesticide residue etc. In order to treat higher quantity of seeds, a large area atmospheric pressure plasma source is developed by using surface dielectric barrier discharge. Figure A.1.7 shows such a system where the effective plasma treatment area

is 800 mm x 800 mm.

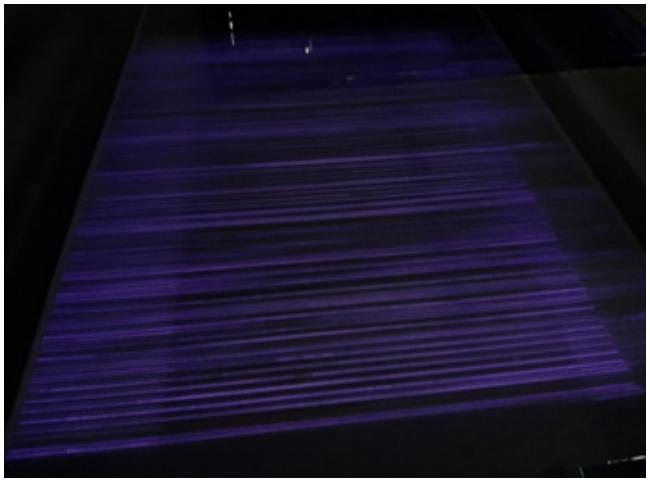

Figure A.1.8: Air plasma generated on 800 mm x 800 mm electrode area.

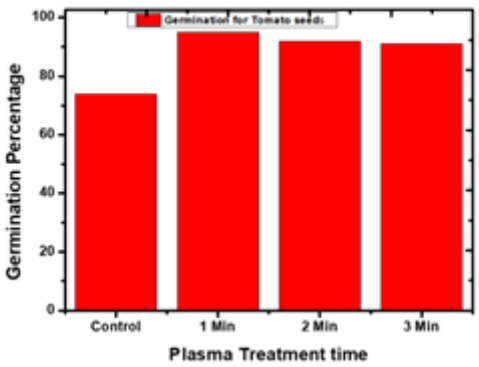

Figure A.1.9: Germination percentage of Tomato seeds after air plasma treatment.

The figure A.1.8 shows air plasma generated on 800 mm x 800 mm electrode area. The seeds which need to be treated are spread on a movable platform and kept below the plasma electrodes. Currently plasma treatment of tomato, capsicum and okra seeds are being carried out in the system. As shown in figure A.1.9 germination percentage of plasma treated tomato seeds increases by 30 % when treated for 1 minute. In addition, cumin seeds are being treated for reduction in pesticide residue.

Use of Plasma Activated Water (PAW) in dairy sector: Chemicals like Alcohol, H_2O_2, Chlorine and Chlorine compounds etc. are commonly used as disinfectants. These chemicals can pollute the environment and are relatively costly. Plasma activated water (PAW) is an alternate solution. Institute has developed a technology to produce PAW with properties optimized for different applications (Fig. A.1.10). In a joint study with a Public Sector agency, PAW was used for sanitization of milk cans, dump tank etc. during dairy operations. A significant reduction in the microbial load was observed when PAW is used for final cleaning of containers. Further, the study reveals that only 25 litres of PAW would be required to clean milk containers of 5000 L capacity, leading to significant cost saving.

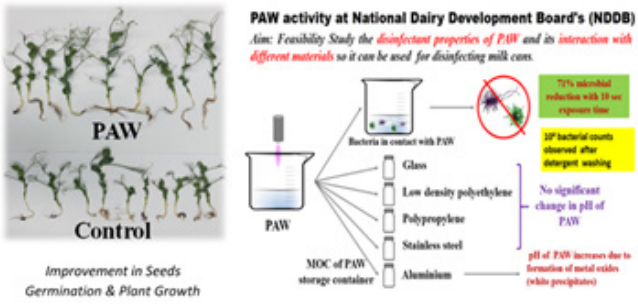

Figure A.1.10: Schematic of use of plasma activated water in dairy sector.

A.1.3 Plasma Thruster Technologies

A helicon plasma thruster with 5kW, 13.56MHz RF source has been developed (Fig. A.1.11) to produce plasma using a helicon antenna and a magnetic nozzle configuration. Helicon plasma is characterized for different operational conditions like working pressure (1-5 x10^{-3} mbar), magnetic field

(600-1800 G) and RF powers (0.5-5kW) to study plasma parameters and understand the thrust generation mechanism for detailed characterization.

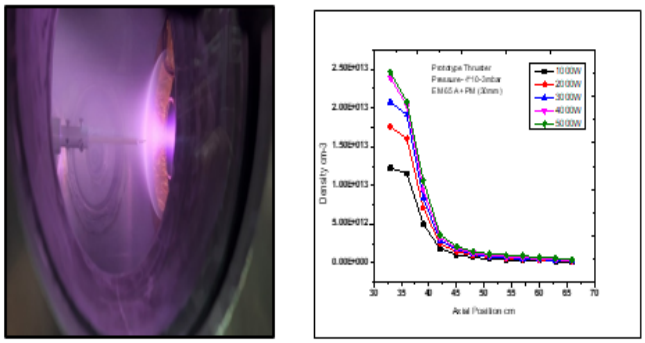

Figure A.1.11: Measured density in source region.

A set of electrical probe diagnostics like Langmuir probes, mach probes and Optical Emission Spectroscopy (OES) are deployed for the detailed characterization of plasma in both near source (antenna) and in expansion (magnetic nozzle exit) region. Plasma density and electron temperature are estimated under various experimental conditions.

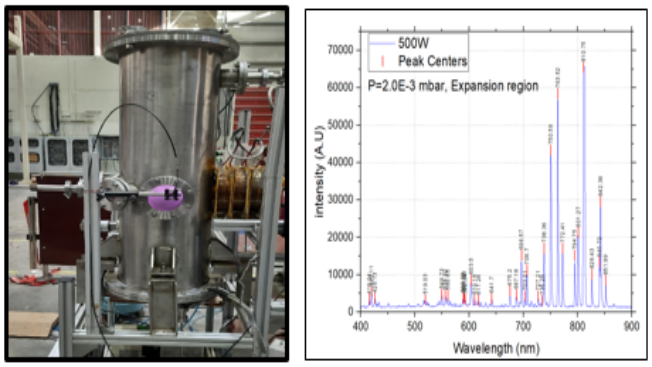

Figure A.1.12: OES spectra for Ar gas Thruster system.

The density achieved in the source and the expansion regions correspond to >3 x 10^{13} cm^{-3} and > 3 x 10^{11} cm^{-3} respectively. Electron temperature in the source and expansion is estimated 3 - 12 eV which matches well with those obtained using chord averaged optical emission spectra (Fig. A.1.12). Mach probes are used to measure flow velocities of supersonic flow in the expansion zone. Further, new diagnostics like 3D B dot probes, RFEA and Emissive probes are under development for various parameter studies.

A.1.4 Other Technologies

Plasma fireball-mediated ion implantation for nonvolatile memory application: Due to the simple structure (metal/oxide/metal) and extraordinary performance, resistive switching (RS) based nonvolatile memories are expected to fulfil the demand for next generation computing technologies.

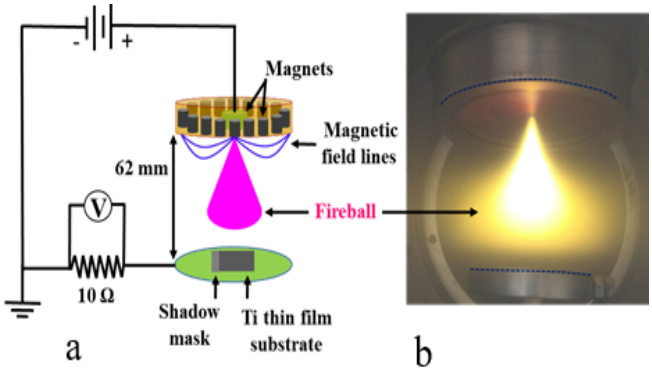

Figure A.1.13: (a) Plasma-based ion implanter (b) Plasma fireball produced using oxygen working gas.

However, to compete with conventional flash memories, quick and low-cost fabrication techniques are essential for the commercialization of RS-based devices. Implementing the plasma-based process using reactive gases (i.e. oxygen) for resistive switching applications is crucial and challenging. Recently, an Ar plasma-fireball-based low-cost technique has been developed in the institute (Indian Patent) to implant oxygen atoms in Ti thin

film. Depending upon the polarity, a single device is used to grow Ti thin film followed by plasma fireball-mediated oxygen ion implantation to transform the top surface of Ti film into a functional TiO_x layer needed to fabricate the device.

In this work, the periodically patterned arrays of oxide-based squared memory cells of different sizes have been fabricated. Figure A.1.13a demonstrates the schematic illustration of plasma fireball setup. A balloon-shaped plasma fireball developed using oxygen ions (O^+) at a discharge voltage of 550 V is shown in figure A.1.13b. Initially, a Titanium (Ti) film is deposited on a silicon (Si) substrate. Subsequently, oxygen ion implantation is performed. Before implantation, a masking of partial surface area on the substrate is done. At the end of the implantation process, the exposed area of the metal film converts into a functional oxide layer, and the masked area remains as it is (which works as a bottom Ti electrode). It is imperative to mention that only the near-surface layer of the Ti film of the exposed area is transformed into the TiO_x layer. The oxygen implanted part consists of three layers (TiO_x/Ti/Si). The underside part of the film in the implanted region, i.e., the Ti layer, is connected to the masked Ti film.

Figure A.1.14 (a) shows the two-fold flipping of current levels (LRS: low resistive state and HRS: high resistive state) at the nanoscale level to confirm the non-volatile memory characteristics of the device. A nano-sized AFM tip works as a dynamic top electrode and scans the surface, resulting in the flipping of the current state of a particular area depending upon the polarity. Further, the applicability of the plasma-fireball-based ion implantation technique is demonstrated for the rapid fabrication of periodic arrays of TiO_x-based squared memory cells of different sizes (Fig. A.1.14b & c). The Ti-coated Cu-TEM grids of different mesh sizes are used as a mask for patterning periodic memory cells during ion implantation. It is observed that regularly spaced square TiO_x memory cells are formed for all the arrays, and the edges of each memory cell are sharper and well defined. The black portion represents the TiO_x and the lighter area corresponds to Ti film, exhibiting better contrast between the two adjacent memory cells. The size of the memory cells is measured in the range of 20 µm to 40 µm depending upon the number of meshes in the TEM grid. The minimum spacing between two adjacent TiO_x memory cells is noted at about 5 µm (Inset of Fig. A.1.14c). This study opens up a new avenue for the quick preparation of nanoscale non-volatile memory devices using a simple and cheap plasma fireball based method.

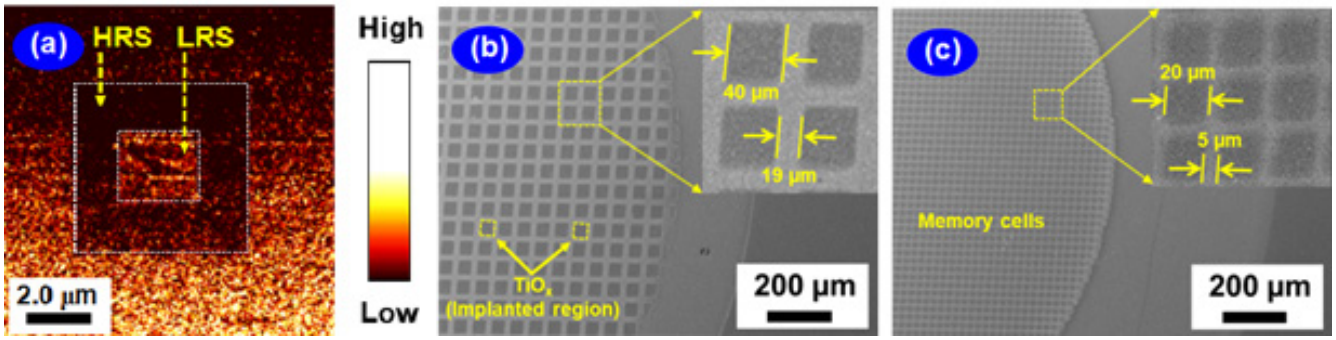

Figure A.1.14: (a) Demonstration of two-fold erase-write process. Field emission scanning electron microscopy image of a periodic array of TiO_x-based squared memory cells of different sizes fabricated by plasma fireball using masking method. Memory size (b) 40 µm and (c) 20 µm.

Development of High Power Impulse Magnetron Sputtering System (HIPIMS): In HIPIMS, (High Power Impulse Magnetron Sputtering) some of the metal atoms sputtered from the target are themselves ionized. The ionised metal atoms help in improving quality of thin film. The main advantage of coating produced by HIPIMS is that they are denser, harder and smoother coatings as compared to conventional thin film deposition techniques like DC magnetron sputtering (DCMS). An Ultra high vacuum sputtering system has been developed in which four (04) sputtering guns are installed, figure A.1.15. This makes use of a pulsed power supply to deposit thin films by using HIPIMS.

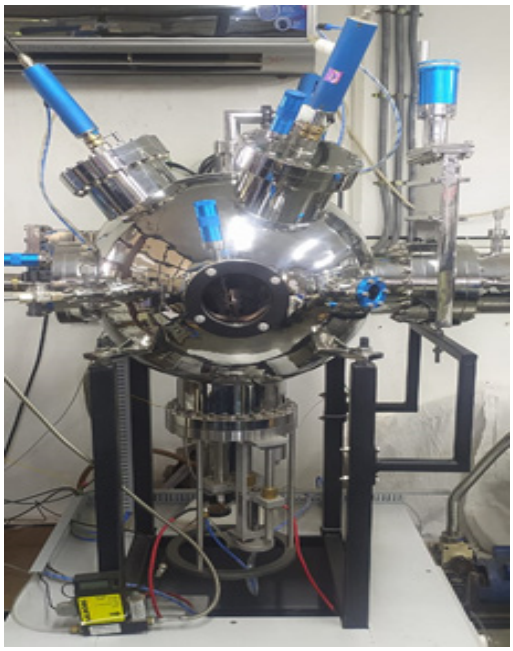

Figure A.1.15: UHV sputtering system.

Copper thin films have been deposited using both DCMS and HIPIMS and their properties are compared. It is observed that HIPIMS shows higher ionization/excitation of copper as compared to DCMS. Moreover, the plasma density during pulse on period of HIPIMS is one order higher than DCMS. However, at the same power, the deposition rate in case of HIPIMS is lower than DCMS. Further, a comparison of the films produced by HIPIMS and DCMS, Figure A.1.16, shows that the films produced by HIPIMS are not only compact and dense but also free from any columnar growth.

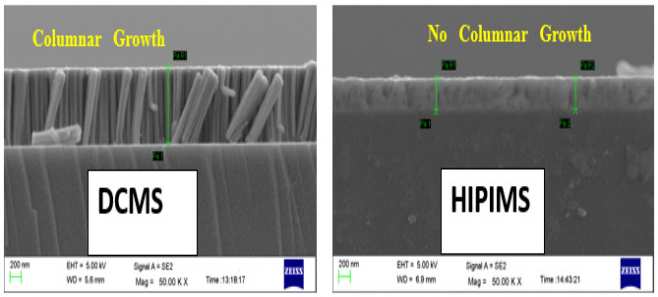

Figure A.1.16: Cross sectional images of copper coating.

Green Hydrogen: Plasma Electrolysis: The already matured, commercially-available water electrolysis systems are alkaline electrolyzer (AE) and proton exchange membrane (PEM). An emerging technique is Plasma Electrolysis or contact glow discharge electrolysis (CGDE).

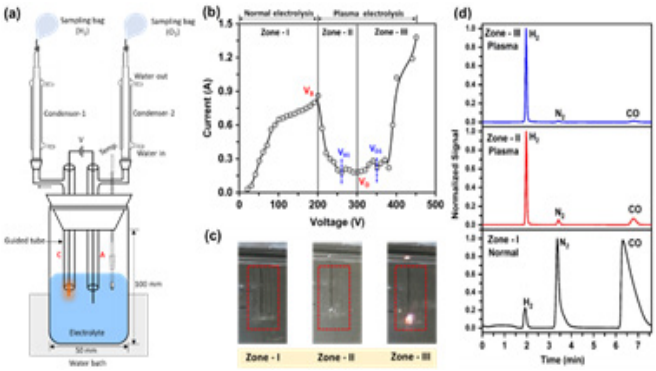

Figure A.1.17: (a) Schematic of the plasma electrolyzer (b) I-V characteristics during electrolysis under liquid (c) Photographs of the cathodic plasma electrolysis at different zones (d) Gas chromatographs of the collected samples.

Institute has conducted preliminary experiments on plasma electrolysis, the results of which are shown in figure A.1.17. Initial results are promising, and further R&D is in progress to improve the energy efficiency.

Design, development and characterization of resistive arm based planar and conformal metasurfaces for RCS reduction: In RADAR stealth application, the value of radar cross section (RCS) determines the maximum detection range of potential targets like aircraft, submarines, ships, missiles. Therefore, it is important to reduce RCS of these targets so that they cannot be detected by the enemy's radar, which improves its battlefield viability and penetration ability. In previous studies, most of the reported designs of Metasurfaces based absorber present 10dB reflection reduction value which is not sufficient for highly sensitive defence application. Only a few reported studies proposed a computational design of 20dB reflection reduction value, however, their experimental characterization has not been reported.

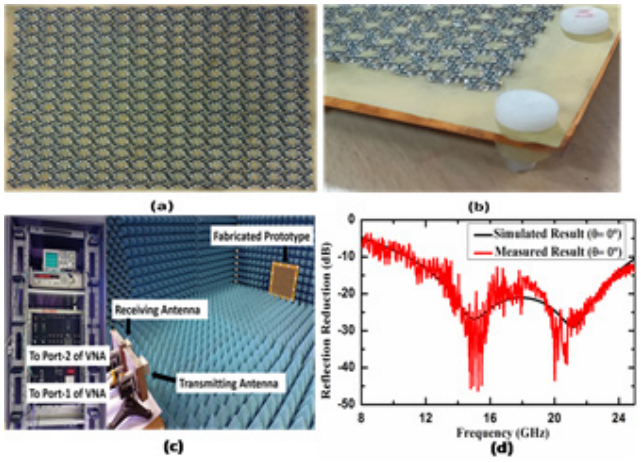

Figure A.1.18: (a) Top view, (b) 3D view of fabricated prototype, (c) experimental setup, (d) simulated and measured reflection reduction characteristic of the developed planar meta-surface absorber under normal incidence.

In addition, the potential target in defence application have planar as well as non-planar surfaces, therefore it is necessary to study the performance of the proposed Metasurfaces absorber on conformal surfaces, as well. All the previously reported works have limitation in terms of reflection reduction value, fractional bandwidth and different geometrical shapes of conformal Metasurfaces (Fig. A.1.18).

To address these issues as well as to avoid the detection range of highly sensitive Radars, first time we have designed, developed and characterized a broadband (13.42 to 22.66 GHz), polarization-insensitive Metasurfaces Absorber (MA) which exhibits 20 dB reflection reduction for 51.21% fractional bandwidth under normal incidence with 0.12λL thickness (where λL corresponds to lower operating frequency). In addition, different geometrical shapes of conformal Metasurfaces (cylindrically bent and 90^{o} dihedral surface) have also been demonstrated both numerically and experimentally. RCS reduction capabilities of developed Metasurfaces absorber on planar and conformal surfaces shows that it can be efficiently used as a standard absorbing device to reduce RCS of potential targets in radar stealth application.

One-step synthesis of ferromagnetic α-MoO_3 nanomaterials with surface oxygen vacancies: Ability to induce oxygen defects in nanomaterials is important as it may endow some special characteristics in the product including ferromagnetic properties. Through a novel thermal plasma assisted method developed at the institute, it has been demonstrated that α-MoO_3 nanomaterials may be generated with pronounced surface oxygen vacancies, without any additional process of hydrogenation, even while

maintaining a large rate of production (sub-kg/h). Presence of the defects was confirmed by the Raman, X-Ray photoelectron spectroscopy (XPS) and electron spin resonance (ESR) techniques. Through VSM, the maximum induced magnetization was measured as 1.84 emu/g, which was more than six times larger than the previously reported maximum value for molybdenum oxide engineered through an elaborate, additional process of low temperature plasma hydrogenation. These nanomaterials are magnetically strong enough and may be controlled with a 2 KGauss permanent magnet, even when remaining dispersed in an aqueous solution.

Nano science and technology: Interactions along with system demonstration with an Indian industry led to the finalization of technology transfer on metal oxide nano-powder production. A one day on site training was also provided to the industry personnel for operation of plasma system and nano-powder generation (Fig. A.1.19). An ISRO funded project on Boron Nitride (BN) nanostructures was successfully completed. The project involved carrying out studies to synthesize BN nanostructures. After a series of trials and varying process parameters pure hexagonal BN NPs and 1-D BN structures (nanotubes and nanowires) were synthesized and handed over to Vikram Sarabhai Space Centre (VSSC), Thiruvananthapuram.

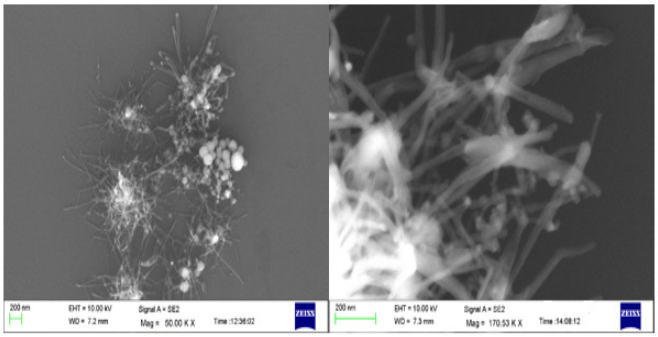

Figure A.1.19: SEM images showing BN nanowire like structure formation.

Calorimetric study of hydrogen plasma stream: Heat flux is an important parameter of plasma stream of pulsed plasma accelerator (PPA) as its knowledge will be helpful for studies related to material surface interaction relevant to materials of fusion interest. A copper calorimeter assembly for the purpose consists of thermocouples inserted in a copper block fixed to a feedthrough. Such an arrangement helps to carry out the measurements at different spatial positions. Four thermocouples are connected to the four channels of the calorimeter controller interface. This controller interface is then accessed through the calorimeter software using an Ethernet LAN cable.

Experiments are carried out at a discharge voltage of 15 kV (Fig. A.1.20) for different plenum pressures of 0.4, 0.9, 1.4, 1.9, 2.4 and 2.9 bar. The measurements are taken at different spatial positions of 6, 8, 10, 12, 16, 24 and 28 cm from the exit of electrode assembly and the data is under analysis. The maximum heat energy density found to be of 0.224 MJ/m^2.

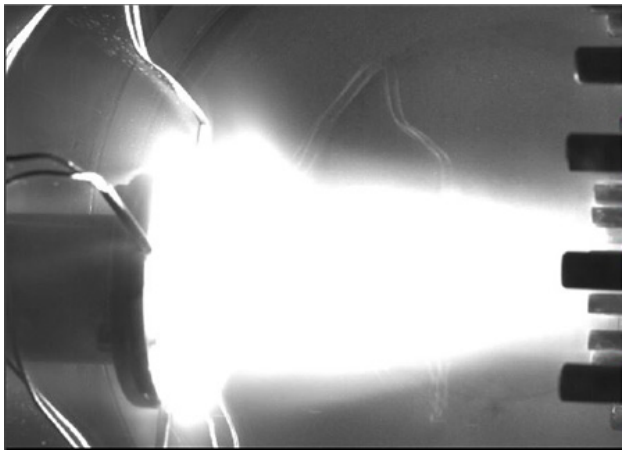

Figure A.1.20: One of the hydrogen plasma beam stream interactions with the copper block of calorimeter.

Aerodynamic drag reduction of automobiles using DBD Plasma: Institute has initiated experiments

to reduce aerodynamic drag in automobiles using plasma. A wind tunnel with a test chamber size of 250mm X 250mm X 500mm and with a maximum wind velocity of 20m/s has been developed for demonstrating the drag reduction using plasma actuator (Fig. A.1.21).

Figure A.1.21: In-house developed subsonic wind tunnel for drag reduction experiment.

The surface flow modification is demonstrated on the aerofoil surface using smoke visualization technique (Fig. A.1.22). A high precision drag measurement system was also developed to measure the drag accurately the drag changes. The drag reduction experiments were performed on the standard automobile models (Ahmed body) and consistent reduction in drag was observed when plasma the panel was actuated. Simulation activity has been initiated to verify the experimental results. The simulation results are in agreement with the experimental results. Design activity for experiments with scaled up models (Fig. A.1.23) using larger wind tunnel is in progress.

Recently Tata Motors Pvt Ltd. has shown interest in collaborating with the institute for developing this technology of drag reduction, to a level where it can be implemented in real vehicles.

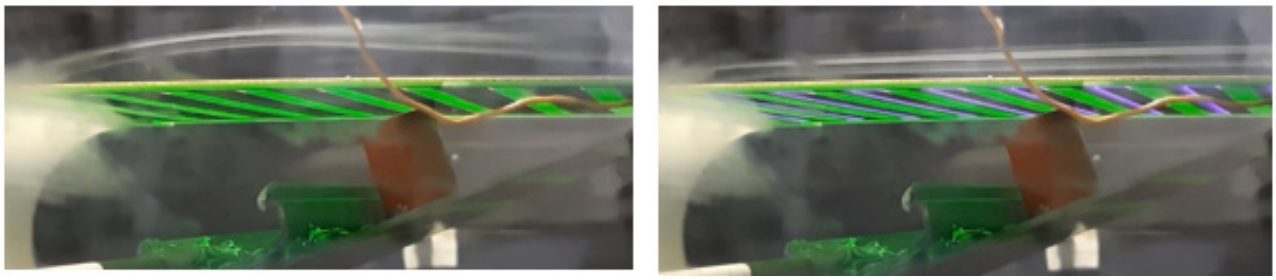

Figure A.1.22: Smoke visualization of surface flow over an aerofoil without and with plasma.

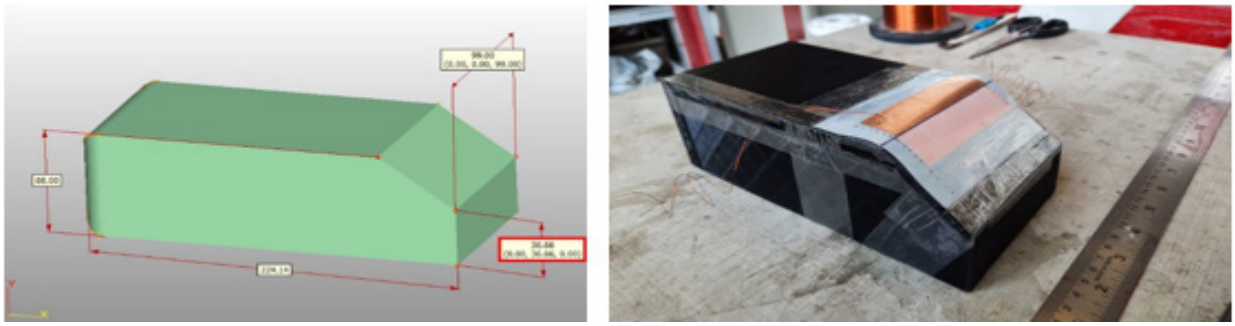

Figure A.1.23: Scaled up models of Ahmed body and automobile.

A.1.5 External Projects

A) PROJECTS COMPLETED				
Sr. No	**Organisation**	**Description**	**Deliverables**	**Status**
01	ITER Organization	EMC3-Eirene simulations of main chamber recycling on ITER	Simulation reports for recycling	All the deliverables of the project successfully delivered.
02	Accumax Lab Devices Private Limited	Feasibility study on surface activation of polystyrene using low pressure plasma	Feasibility study report	Experiments completed. Feasibility study report submitted to Accumax. Discussion for phase-2 are in progress.
03	VSSC, ISRO (RESPOND Program)	Development of boron nitride nanotubes & its characterization for space plasma thruster applications	BN Nano powder (less than 100 nm size)	The objectives of the project completed and the samples were hander over. The RESPOND committee suggested to conduct few more characterization tests on the samples and is likely to be extend the project till July 2023. Official confirmation awaited.
04	Indira Gandhi Centre for Atomic Research	Supply of Pulsed power supply for Plasma Nitriding system	System supply	System delivered and installed at IGCAR successfully.
05	IIT Gandhinagar (IMPRINT – MHRD)	Advanced nano tracers for product life cycle assessment & product monitoring	Process development of isotopic nanoparticles. Delivery of iNP.	Experiments are in progress. IPR's scope in the project is completed.
06	VSSC, ISRO	Plasma erosion Characterization of anode liner materials	Material Characterization report with erosion studies.	All the tasks as per the scope specified are completed successfully. Final report prepared and submitted to VSSC.
07	DST, New Delhi	Development of indigenous technology for CZTS absorber based solar cell using industry friendly magnetron sputtering & RTP sulphurization process.	Process for CZTS films using magnetron sputtering and RTP sulphurization technique.	Project completion report prepared and submitted to SERB. Project closed technically and financially.

B) PROJECTS STARTED				
Sr. No	**Organisation**	**Description**	**Deliverables**	**Status**
01	Gujtex Engineering Company	Supply of 25 kW Graphite Electrode based plasma torch assembly	Supply of graphite based electrode system for 25 kW capacity	Electrodes and power supplies for the system have been procured and tested successfully. Integration is to be done once the site (Vendor's end) is ready.
02	Institute of Pharmacy, Nirma University	Supply of Dielectric Barrier Discharge (DBD) based plasma system for conducting feasibility study for treating waste water	Supply of DBD based plasma system	Design completed and procurement of components is in progress.
03	ITER Organization	Radiation calculations support for penetration working groups (additional scope)	Radiation calculations for Batches set 13 & 14 and Nuclear analysis for local shielding	Work is in progress. Subtask E, D15 & F are completed and reports submitted to IO.

C) TECHNOLOGY TRANSFER AGREEMENTS EXECUTED			
Sr No	**Name of Organization**	**Technology**	**Executed on**
01	Pruthvi Beverages Private Limited	Technology transfer for Plasma activated water generation system	Technology transfer agreement was executed on 02nd June, 2022.
02	Excel Industries, Mumbai	Technology transfer for Plasma pyrolysis system for bio-medical waste disposal	Technology transfer agreement was executed on 22nd June, 2022.
03	FCG Hi-Tech Industries	Technology transfer for Metal oxide nano-powder production	Technology transfer agreement was executed on 25th July,2022
04	Cenerge Engineering Solutions	Technology transfer for Agastya-400 liquid nitrogen cooled cryopump	Technology transfer agreement was executed on 01st August,2022
05	Precise Vaccum systems Private Limited	Technology transfer for Agatsya-400 Cryopump	Technology transfer agreement was executed on, 16th November, 2022.

D) MOU/COLLABORATION AGREEMENTS EXECUTED WITH EXTERNAL AGENCIES			
Sr No.	**Name of Organization**	**Title**	**Executed on**
01	Larsen & Toubro Limited	Collaboration on sharing of knowhow and expertise related to Tokamak systems and plasma technologies.	01st April,2022
02	New Age Instruments & Materials Private Limited	Collaboration of development and supply of IPR-SERS templates	28th December,2022
03	Space Application Centre- ISRO	Technical cooperation and capacity building	08th February,2023
04	Lab India Instruments Private Limited	Collaboration of development and supply of IPR-SERS templates	28th February,2023

A.1.6 Atal Incubation Centre at IPR

As a step to support 'Atmanirbhar Bharat' campaign of Govt. of India, DAE had announced establishment of Incubation Centres at 5 organizations of DAE, viz. BARC, IGCAR, RRCAT, IPR and VECC in Oct 2020. Subsequently, DAE approved an Incubation Policy in Feb 2021 as a guidance for all incubation centres of DAE. In continuation to this, Niti Aayog in January 2023 approved the recognition and funding of Atal Incubation Centre (AIC) at the institute. Under this initiative, the AIC shall be funded by Atal Innovation Mission (AIM), Niti Aayog for a period of 5 years as per the provisions and guidelines of AIM for incubators.

A.2 Fundamental Plasma Physics

Naturally occurring plasma is found in abundance in our universe and interacts with us directly or indirectly in our day to day life. Plasma created in laboratories is characterised under various experimental conditions to explore its fundamental nature and proprieties which not only lead to a better understanding of the various areas of physics interest but also can be exploited for several applications of importance to the society,industry and power plants. Several small to moderate sizes experimental devices have been set up and upgraded to enable such fundamental plasma physics studies.

A.2.1 Large Volume Plasma Device (LVPD) – Upgrade

The plasma of LVPD-U has been characterised for density, temperature, potentials and their respective fluctuations in source, EEF and target regions at various charging conditions of electron energy filter (EEF) after the installation of large area multi-filamentary plasma source (LAMPS). LAMPS has 162 numbers of 0.5mm diameter and 18cm long tungsten filaments feeding a filament current of 3400A at 12.5V. A high level of plasma quiescence in the source plasma has been observed while operating the LAMPS at its full capacity. The plasma region is identified for the electromagnetic whistler wave excitation studies.

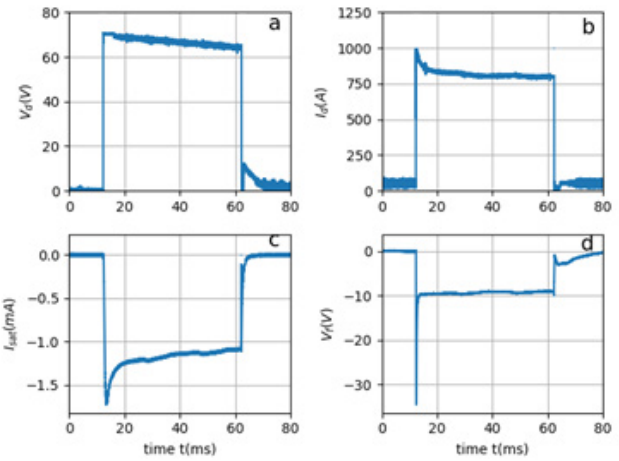

Figure A.2.1: Typical discharge parameters namely, a) discharge voltage, b) discharge current, c) ion saturation current and d) floating potential for 50ms operation of LVPD-U using LAMPS as plasma source.

For this purpose, a 50cm diameter Helmholtz coil has been designed, fabricated and tested along with a loop antenna (10cm diameter) as the exciter. The coil can generate pulsed magnetic field of 0.1T. The synchronous operation of the Helmholtz coil with the loop antenna is tested for DC as well as slow and fast ramping of Helmholtz coil to examine rapid variation of magnetic null region spatially. The optically isolated trigger signals are generated using an Arduino-Uno microcontroller and interfaced to power supplies ranging from 150V-15kV. The Helmholtz setup has also been modelled in AMPERE code for realistic data generation to supplement the experiments. Apart from these, MATLAB routines are also developed to simulate the excitation of Helmholtz field and to carry out the background magnetic field cancellation to produce the magnetic null region, required for future investigations in LVPD-U.

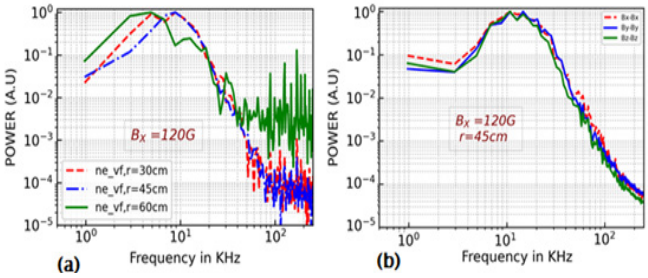

Figure A.2.2: Typical (a) cross-power spectrum between the density and potential and auto power of magnetic field fluctuations (b) are shown for EEF charging field of 120G.

Investigations on plasma characterization in the target region of LVPD-U exhibit presence of finite gradient in density and electron temperatures in the target plasma having scale lengths Ln ~ 60cm accompanied with significant presence of density, potential and magnetic field fluctuations. The parametric fluctuations are found to be well correlated with each other and the frequency spectra peak is in the domain of electron magneto hydrodynamic scale. The excited turbulence has electromagnetic nature. Figure A.2.2 shows the typical spectrum for the density, potential and magnetic field fluctuations at an EEF excited magnetic field, B_{EEF}=120G, where B_{EEF} is perpendicular to B_z. Detailed spectral analysis is underway to identify excited modes in the target and EEF plasma regions.

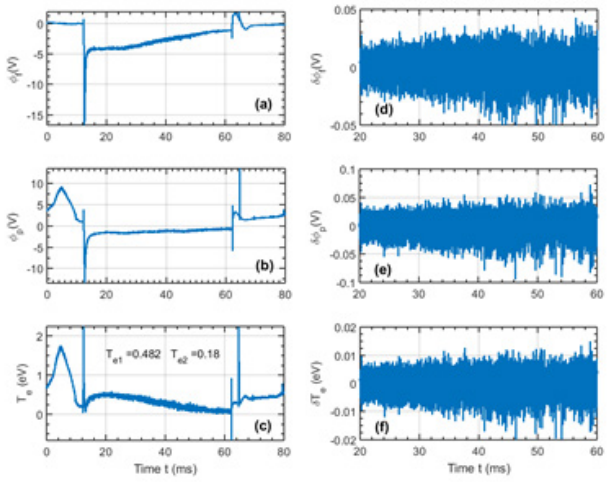

Figure A.2.3: This shows simultaneous measurement of a) floating potential, b) plasma potential, c) electron temperature and their respective fluctuations.

Further, a new probe to carry out real time simultaneous measurement of electron temperature and its fluctuations has been developed. The probe consists of a pair of in-situ placed Langmuir and centre tap emissive probe. The Langmuir probe determines the floating potential while emissive probe measures the plasma potential by satisfying the condition of plasma Maxwellianity and is advantageous over other electrical diagnostics especially for the instability identification related to electron temperature fluctuations (Fig. A.2.3). A theoretical model explaining the results of this diagnostics in-

cluding the correction terms is also developed.

A 60W, 10.6µm, CO_2 LASER system has been procured, installed and tested for its functionality. This systems is a part of LASER heated emissive probe diagnostics to be used for the measurement of plasma potential and its fluctuations. The other upgrades include a procurement and installation of a 22GHz microwave source along with flexible wave guides and oscillators, and automation of real time data logging with a 128 channel data logger. In order to ensure fail safe operation of both dish-end domes, Hall sensor based magnetic proximity read switches are used to control the hydraulic clamps.

A.2.2 Non-Neutral Plasma Device (SMARTEX-C)

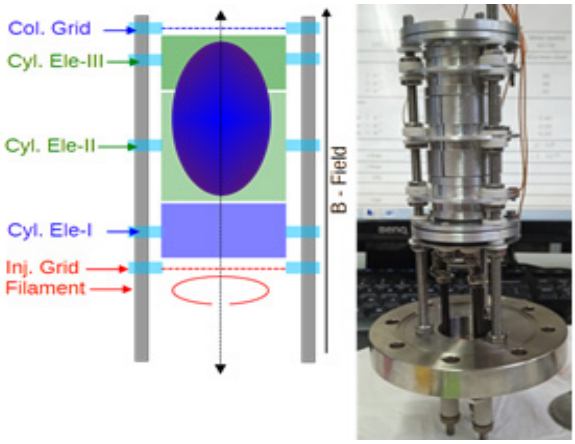

Figure A.2.4: (Left) Schematic arrangement of cylindrical ion trap electrodes (right) Photograph of assembled trap.

Erection of the Cylindrical Penning-Malmberg trap experiment for electron or ion plasma having 1kG magnetic field and operating at 4.0 x 10^{-8} mbar pressure has been completed, Figure A.2.4. Electron plasma has been confined for more than 50 ms in this trap. Preliminary experiments of ion (H^+ predominantly) plasma in cylindrical Penning-Malmberg trap have been carried out.

Radial potential profile of electron plasma, (Fig. A.2.5) for different filament bias configurations has been obtained using High Impedance Langmuir Probe (HILP).

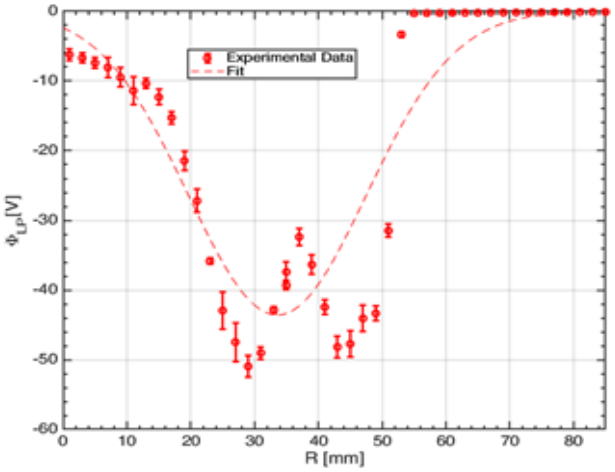

Figure A.2.5: Radial profile of floating potential of electron plasma obtained using high impedance Langmuir probe soon after injection phase.

Additionally, experiments with gases of different ionization potential have been performed in the device for indirect estimation of electron plasma temperature using Gas-Puff diagnostics and temperatures in the range of 3-6 eV has been estimated.
Analysis of diocotron mode damping during unstable plasma phase as a function of background gas, neutral pressure, and resistive wall has been analyzed. In quiescent electron plasma, damping of launched diocotron mode as a function of launch amplitude has also been analyzed. Fourier power spectrum of the modes suggest that second harmonics of the fundamental mode is dominant (Fig. A.2.6).

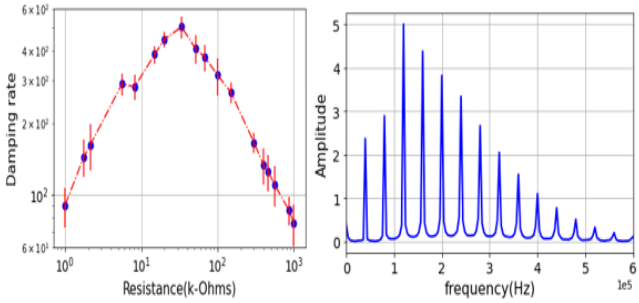

Figure A.2.6: (Left) Damping rate of diocotron mode as a function of wall resistance (Right) Power spectrum during mode damping phase.

As an upgrade, newly fabricated vacuum vessel for SMARTEX-CU (Fig. A.2.7) along with its support structure has been tested for leaks with the rate of 2.0 x 10^{-9} mbar l/sec.

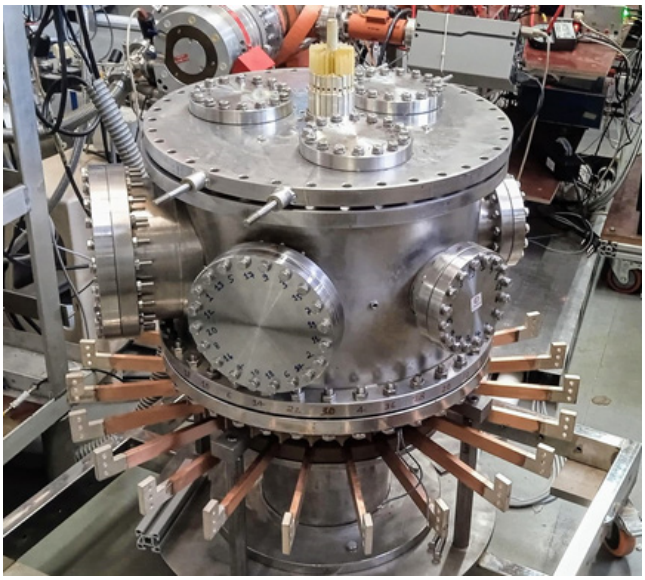

Figure A.2.7: Newly fabricated SMARTEX-C vacuum chamber along with toroidal field coil bus-bars, and support structure.

A.2.3 Multi-Pole Line Cusp Plasma Device (MPD)

Ion Acoustic Solitary waves are also excited in the plasma confined in this unique multi-pole line cusp plasma device (MPD), in which the magnitude of the pole-cusp magnetic field can be varied. In addition, by varying the magnitude of the pole-cusp magnetic field, the proportion of the two-electron-temperature components in the filament-produced plasmas of the MPD can be varied. The solitons are experimentally characterized by measuring their amplitude-width relation and Mach numbers. The nature of the solitons is further established by making two counter-propagating solitons interact with each other (Fig. A.2.8). Later, the effect of the two-temperature electron population on soliton amplitude and width is studied by varying the magnitude of the pole cusp-magnetic field. It has been observed that different proportions of two-electron-temperature significantly influence the propagation of IASs. The amplitude of the solitons has been found to be inversely proportional to the effective electron temperature (T_{eff}).

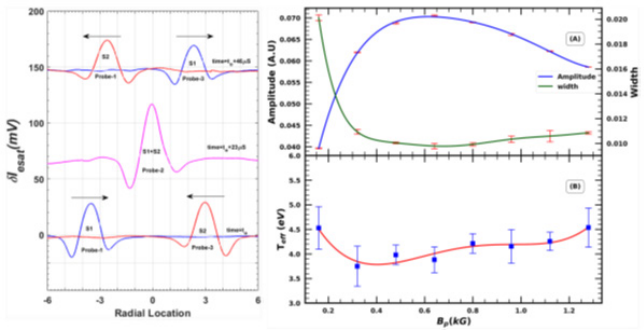

Figure A.2.8: (Left) Radial propagation of solitons and (right) effective electron temperature, soliton amplitude and with is shown as a function of pole cusp magnetic field.

A.2.4 Basic Experimental Toroidal Assembly (BETA)

In BETA (aspect ratio R_0/a=45cm/15cm), the mag-

netic field produced by plasma discharge current is negligible (~5A) and hence is often called "current-less" toroidal plasma device. Consequently, the confinement of particles and energy is only due to external toroidal and vertical magnetic fields. Presently, toroidal confining magnetic field lines and absence of rotational transform (B_θ=0) of low temperature(T_{e0}=5eV) plasma in BETA simulates main features of the magnetic field geometry at tokamak scrap-off-layer. Therefore, to understand equilibrium and transport in a magnetic flux surface configuration of current-less plasma, development of setup for external rotational transform or external-q ($q_{ext}=rB_\phi/RB_\theta$) experiments is in progress.

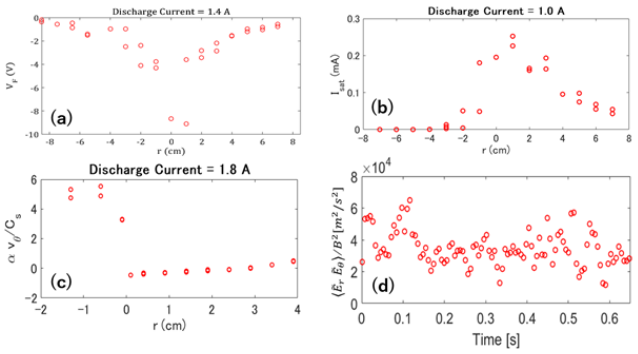

Figure A.2.9: (a) Radial profile of floating potential for discharge current =1.4A, (b) Radial profile of ion saturation current for discharge current =1.0A, (c) Radial profile of net poloidal flow velocity (not calibrated) measured by Mach probe, and (d) Temporal profile of Reynolds stress:

A poloidal component of magnetic field will be introduced by installing a toroidal copper conductor at the minor axis of the vacuum vessel. The design of toroidal current-carrying copper conductor and its supporting structure has been completed. Support structure has been fabricated whereas the conductor is currently under fabrication. Design of copper bus bars to carry current to the conductor has been finalized. For the experiments electric probes such as Mach probe, Reynolds stress probe, and their electronic circuits have been developed for the measurements of the plasma parameters such as mean and fluctuations driven flows.

A.2.5 Dusty Plasma Experiment Device (DPED)

Square lattice formation in a monodispersive complex plasma: Institute has reported the first observations of a square lattice formation in a 2D dusty plasma crystal, generated during experimentation and corroborated using molecular dynamic simulations (Fig. A.2.10). The findings have applications in material science research, where structural transition events are important in understanding soft material systems.

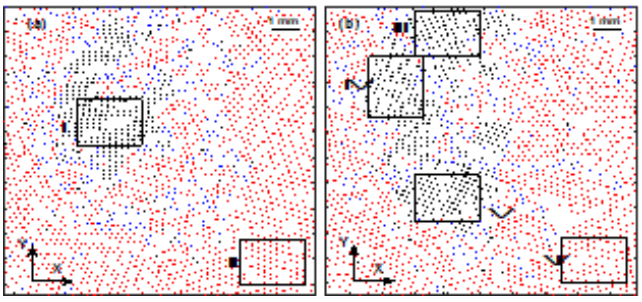

Figure A.2.10: (a) and (b) Square domains at two different discharge conditions.

Plasma sheath in the presence of dust particles in a magnetic mirror-like field configuration: A plasma sheath containing dust grains in an inhomogeneous magnetic mirror-like field configuration has been investigated for the first time. There is a possibility that such a magnetic field configuration may be helpful in exploring different unknown properties of the sheath. The plasma fluid model has been used to investigate the problem. A low-pressure plasma ($T_i<<T_e$) consisting of electrons, singly charged cold ions, and negatively charged dust

grains is considered. A three-fluid hydrodynamic model has been adopted to solve the problem. A non-uniform magnetic field, which is similar to the magnetic mirror, having an axial symmetry, is introduced. In the presence of dust grains, the ions and electrons in the plasma are attached to it, and the respective currents to the dust grains are governed by the OML (Orbital Motion-Limited) theory. The sheath formation criterion gets modified in the presence of ion-neutral collisions and magnetic fields. The results of the study reveal that the magnetic mirror field has a significant effect on the properties of the sheath. An entirely new kind of behavior is exhibited by the ion density, ion velocity, and space charge near the surface. Individually, both magnetic field and ion-neutral collisions try to restrict the movement of the ions toward the surface. However simultaneous presence of both entities leads to a different type of behavior due to the ion-neutral collisions reducing the effect of the external magnetic field and aiding the ions motion towards the wall.

Fore-wake phenomena in between two charged objects: Fore-wake excitations ahead of a rapidly moving object in a fluid is a spectacular phenomenon in hydrodynamics that has often been observed ahead of moving ships or speed boats near the coast. However the same has not been investigated in plasmas where the fluid model holds good for low frequency excitations. Very recently, some of these fore-wake structures e.g. precursor and pinned solitons have been observed in laboratory dusty plasma experiments when the dust fluid is made to flow over a charged object. To understand the effects on the fore-wake structures when excited in between two charged objects in a flowing dusty plasma, experiments have been conducted in an inverted Π-shaped dusty plasma experimental device in which the dusty plasma is created in a DC glow discharge argon plasma using micrometer sized kaolin particles. Two copper wires at variable distances are installed radially on the cathode to serve as charged objects.

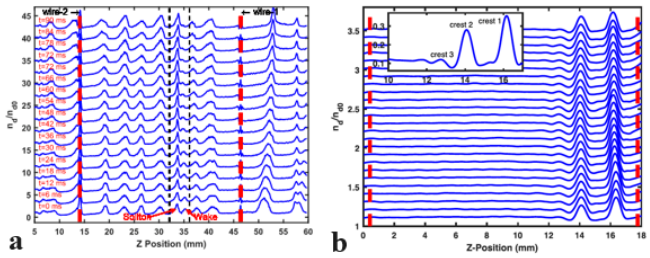

Figure A.2.11: a) Time evolution of precursor solitons and wakes excited by two charged objects simultaneously when the distance between them is approximately 3 cm. The compression factor (n_d=n_{d0}) is plotted in the interval of 6 ms and for a better visualization, a shift of 2.6 is given. b) Figure shows a typical trapping of the wave in between two charged objects (indicated by red dashed lines). The intensity profile of the wave is plotted at the interval of 5.1 ms. The inset shows the zoomed view of three crests of a particular wave.

A single gas injection technique is employed to generate a flow in the dust fluid. Precursor solitons and wake structures are excited by each of the charged objects when the dust fluid flows supersonically over them. In the frame of the fluid, the solitons propagate in the upstream direction, whereas the smaller amplitude wake structures propagate in the downstream direction. A soliton, excited by one of the objects, interacts with the wake structure generated by the other object in the region between the two charged objects. After the interaction, the amplitude and velocity of the soliton increases whereas its width decreases. In another set of experiments, the wave gets trapped in between the wires when their separation is kept below a critical value of 2 cm. For a long time (of the order of a few seconds), the trapped-wave structure retains its

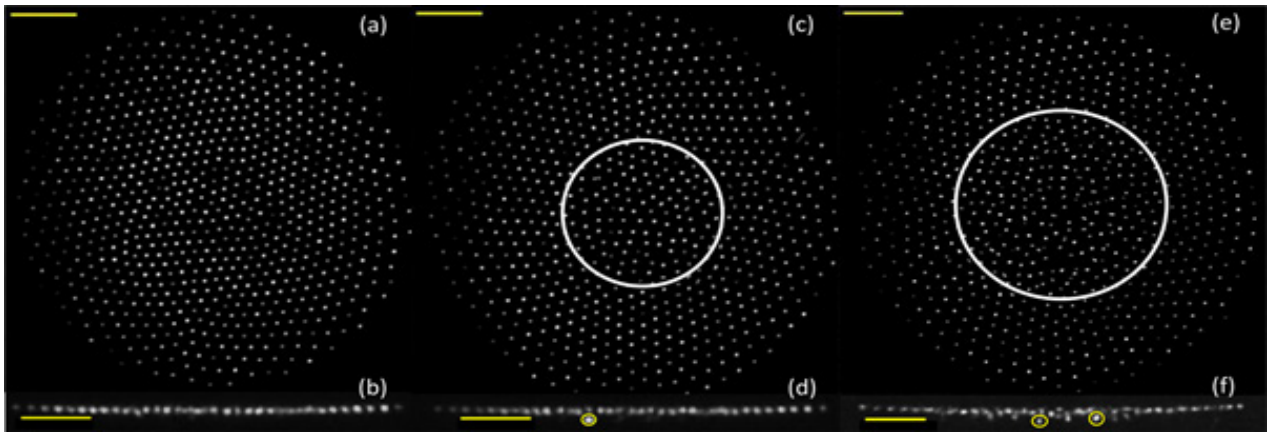

Figure A.2.12: Top [(a), (c), and (e)] and side [(b), (d), and (f)] views of dusty plasma structures at different discharge conditions. (a) and (b) The top and side views of a typical monolayer crystal at V_d~400 V and p~6 Pa, (c) and (d) the in-plane oscillation state at V_d~400 V and p~5.2 Pa, and (e) and (f) the liquid–solid phase coexistence state with liquid state at the center and crystalline state at the periphery at V_d~400 V and p~4.1 Pa. The encircled particles in (d) and (f) indicate the stray particles. The scale bar in all the subfigures is 1 mm.

identity. The amplitude of the wave crests and the distance between them remains constant with the dust fluid flow velocities (Fig. A.2.11). A forced Korteweg-de Vries equation driven by two sources is used to model our experiments and its numerical solutions are shown to reproduce well the main features of our experimental results.

Transition of a 2D crystal to a two-phase coexistence state: A series of experiments is conducted to investigate the behavior of a two-dimensional dust layer under varying levels of radial confinement in DPEx-II device to understand the response of the dust layer when squeezed from the sides. To achieve this, a new technique involving adjustment of the confinement strength while keeping other discharge parameters, like pressure and discharge voltage, constant. The radial trap, which acts as the confinement, is isolated from the grounded cathode and connected to the ground through a variable resistance (potentiometer). By manipulating the resistance value, one can control the thickness of the sheath surrounding the dust layer, thereby regulating the strength of the radial confinement. When one decreases the confinement strength, it is observed that the dust monolayer buckles and square lattice domains are formed within the dust layer, accompanied by dynamic structural rearrangements (Fig. A.2.12). To understand the time scales associated with these observations, the bond-orientational correlation function is used. Through careful examination of the micro motion of dust particles, it is determined that the rearrangement in the quasi-2D dust crystal arises from heterogeneous cooperative motion of particles.

Experimental investigation of spontaneous density fluctuations in a strongly coupled dusty plasmas: Experiments have been conducted to study the theoretical model developed using the Generalized Hydrodynamic model. The model shows the time dynamics of the density auto-correlation function (DAF) for a strongly coupled Yukawa system (Fig. A.2.13). In order to verify the theoretical predic-

tions, the dusty plasma experiments have been perrformed to measure the spontaneous density fluctuations of strongly coupled dusty plasma. Mono-dispersive micron-sized Melamine Formaldehyde particles were introduced in the background of RF plasma to produce the dusty plasma. The kinetic information obtained by capturing dust particles' space and time dynamics with the help of a high-speed imaging system is used to calculate the DAF in the inverse space. The experimental results are compared with the model equations over a range of coupling parameters. The experimental results were found in agreement with the theoretical predictions, and dusty plasma's thermal diffusivity coefficient was estimated for different coupling constants.

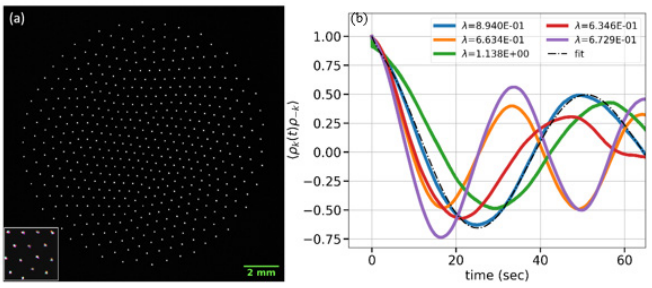

Figure A.2.13: a) An image of dust particles captured from the top-view camera showing spatially symmetric arrangement of the particles. b) Figure showing DAF corresponding to different reciprocal modes from a Dusty plasma experiment with coupling strength Γ_e =1207.4.

A.2.6 Applied Plasma Physics Experiments in Linear Device (APPEL-Device)

APPEL device has been recently commissioned at the institute. The device consists of 16 electromagnets that provide flexible, steady-state axial magnetic field strengths of 0.41T over the axial distance of 3.5 m and 2 % radial uniformity across the diameter of the vacuum chamber. The device is extensively used to study plasma confinement in linear, mirror, and end-cusps configurations; besides the device can be helpful in underpinning the source of deleterious effects during magnetized plasma surface interaction with a material body, which occurs at the Scrape Of Layer (SOL) of the fusion device and/or ICRF antenna surfaces exposed to magnetized plasma.

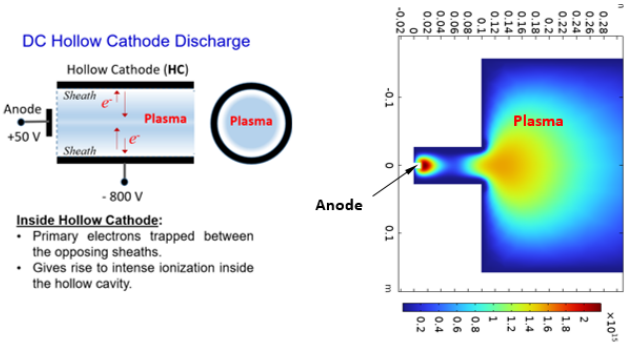

Figure A.2.14: Comsol multi-physics simulation of a cold hollow cathode device has been performed to study the effect of axisymmetric magnetic field on the expanding plasma column inside APPEL device.

A reasonably high-density steady-state elongated horn-shaped plasma column with a length of 3.5 m and density of the order 10^{17} - 10^{18} m^{-3} has been produced in the APPEL device using a cold hollow cathode plasma source with ~0.5 kW discharge power and an applied magnetic field within few percentages of one tesla. The higher densities correspond to the ion flux of the order10^{21} - 10^{22} $m^{-2}s^{-1}$ and fall under the range of plasma wall interaction studies. The computational simulation (Fig. A.2.14) of the hollow cathode discharge has been carried out to match with the experimental observations. Figure A.2.15 shows the magnetized argon plasma column simulated for different values of the magnetic field. For the Helium case the plasma

column is found to be brighter as compared to Argon plasma.

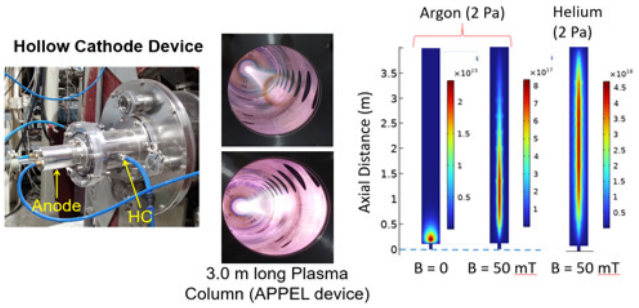

Figure A.2.15: Magnetized argon plasma column simulated for different values of the magnetic field.

Pre-ionization and plasma start-up experiments relevant to fusion devices using spiral antenna in APPEL-Device: The spiral antenna has recently gained popularity and has been used for plasma wall conditioning. To explore the possibility of producing high density plasma using the spiral antenna for plasma pre-ionization and startup in the tokamaks, a linear plasma device maybe the best option due to ease of operation and measurements.

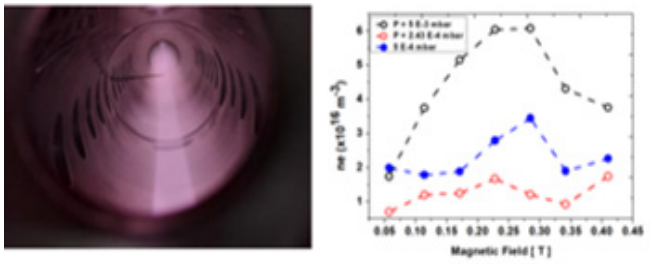

Figure A.2.16: The above figure shows a collimated argon plasma produced in APPEL at a magnetic field strength of 0.4T and a background pressure of $2x10^{-4}$ mbar. The experiment demonstrates the possibility to produce plasma at low pressures with ionization efficiency typically less than 5 % using the helical plasma device provided the magnetic field lines are normal to the plane of the antenna.

Spiral antenna experiments in the APPEL device have been conducted using 13.56 MHz RF power supply, primarily to study the operational regimes that include the operating pressure, discharge power, the magnetic field strengths and the maximum achievable plasma density and its profile. A 3.5m Argon plasma column has been produced in the device with 500 W injected RF power by varying the magnetic field up to B = 0.41T. Initial results have given peak plasma density of the order of 10^{17} m^{-3} for the pressure range 5 x 10^{-3} to 2.0 x 10^{-4} mbar as shown in figure A.2.16.

A.2.7 Basic Experiments in Axially Magnetized (BEAM) Plasma Device

Magnetic field induced electron temperature inhomogeneity effects on discharge properties in cylindrical capacitively coupled plasmas: Controlled plasma parameters namely the electron energy distribution and plasma uniformity over a large area is essentially needed to process silicon substrates in semiconductor manufacturing industries.

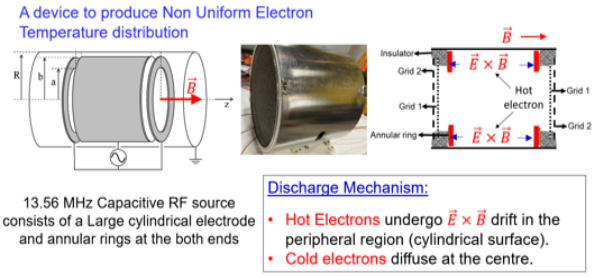

Figure A.2.17: A device to measure non uniform electron temperature distribution.

This has been achieved by imposing an external magnetic field on capacitive driven RF electrodes as shown in the figure A.2.17. The discharge takes the advantage of axisymmetric magnetic field and capacitive coupled RF sheaths to produce inhomo-

geneous electron temperature plasma inside the cylindrical volume. The central plasma column is populated of cold electrons. The energetic electrons originated from the high amplitude Rf sheaths are confined in E x B orbits close to the discharge surface. Low energy electrons migrate at the center via collision transport.

The hotter electron temperature regions are favourable for the excitation of molecular oxygen whereas the colder electrons supports the dissociative attachment process to obtain negative atomic oxygen ion. Figure A.2.18 shows the direct view of the plasma inside the large cylindrical electrode. With the introduction of magnetic field the electron temperature is seen to increase radially.

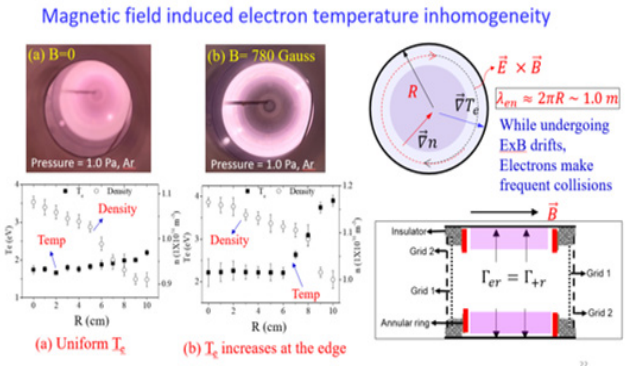

Figure A.2.18: Plasma profile with and without magnetic field and corresponding radial temperature distribution. On the right is the schematic of the density and potential gradient resulting in E x B confinement of electrons.

A.2.8 Stimulated Phenomena in Negative Ion Plasma Experiments (SPIN-eX Device)

Negative ion diagnostics using resonance probe and pulsed laser photo-detachment: The conventional methods to determine negative ion density is based on pulse laser photodetachment. However due to line-of sight accessibility limitation, a new method based on resonance hairpin probe has been developed. Different time response of electrons and negative ions in reaction to the application leads to a sharp rise in the electron density signal during the rise of negative bias to plasma potential (positive). The peak electron density directly corresponds to the negative ion density in the discharge. The probe is inserted in an oxygen plasma created using the large cylindrical device and the negative oxygen density fraction inside the discharge is determined, figure A.2.19.

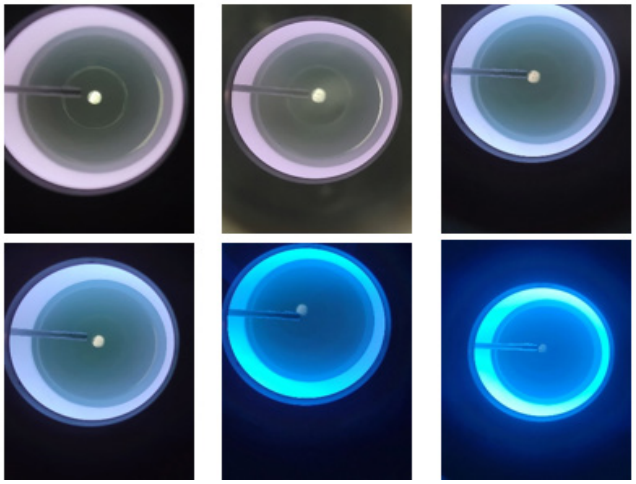

Figure A.2.19: Hairpin probe inserted radially in oxygen plasma. The bright regions at the edge shows the high energy electron population while the core is dominated by negative ions.

In addition, it also demonstrated that the hair pin probe can also be used with conventional pulsed laser photo-detachment experiment to determine absolute value of photoelectron detached electron density. The additional advantage is there are no deleterious interferences on the signal as the probe is floating.

A.2.9 Large Area Multi-Electrode Plasma Source Developed

Large Area Multi-Electrode Plasma Source: A novel multi-electrode RF plasma source has been developed and plasma uniformity of 30 cm, limited to the chamber size, has been demonstrated, figure A.2.20.

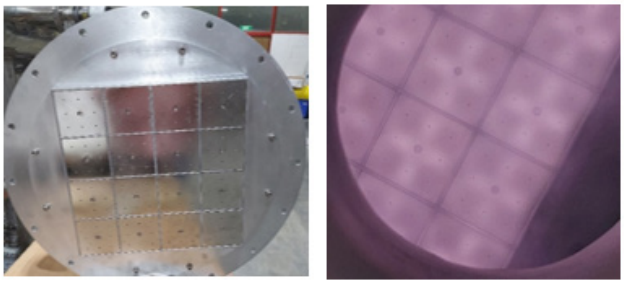

Figure A.2.20: Showing the Large Area Plasma Source developed in-house.

The multiple-electrodes are driven in push-pull mechanism by commercial RF power splitters. However they are designed to be operated for a particular frequency.

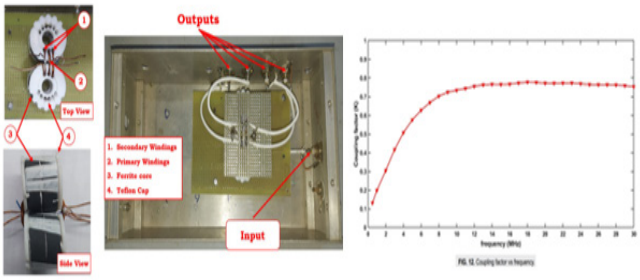

Figure A.2.21: The experimental RF power splitter designed and tested. Shows up to 80 % coupling factor for a wide frequency range tested up to 30 MHz.

To address this limitation a novel 1:4 RF power splitter has been designed, analyzed and experimentally demonstrated, figure A.2.21.

A.2.10 Inertial Electrostatic Confinement Fusion (IECF) Device

Effect of cusp magnetic field on NPR: A Cusp magnetic assembly having field strength of 0.1T is coupled with the cylindrical IECF device to obtain a higher charged particle density and, hence, a higher fusion rate and neutron yield. Samarium-cobalt permanent magnets are used to construct the magnetic assembly, which is inserted inside a cylindrical cage having 12 channels. The assembly forms a cusp magnetic field pattern with a field-free zone in the central region. Charged particles are expected to be trapped in this field-free zone. Further trapping is provided by the electrostatic field with the conventional IECF confinement mechanism. The neutron production rates (NPR) before and after the application of the Cusp magnetic field assembly have been compared. It is observed that while the NPR without the magnetic field is ~4×10^6 n/s, it increases to ~9×10^6 n/s when the magnetic field is imposed at the same discharge voltage of -45 kV.

Study on ion dynamics in a triple-gridded system: A triple-gridded assembly is designed, fabricated and installed in the cylindrical IECF device. The alternate positive and negative biasing on the grids confines the electrons and ions in a region in-between two consecutive grids, and thus forms highly dense region of charged particles. The inner, intermediate, and outer grids have a diameter of 3, 23, and 33 cm, respectively, and are placed coaxially and concentrically inside the chamber. The ion flow dynamics in the triple-gridded arrangement have been studied for different combinations of applied voltages to the grids. The potentials and ion densities have been measured from Langmuir probe data. One of the interesting findings of the study is the shifting of the ion confinement zone from the central part to the region in-between the inner and the intermediate grids. The primary reason for having a densely populated ion region between the inner and intermediate grids is the formation of a potential hill or positive potential barrier near the

inner cathode edge. In order to benchmark the experimentally observed results, a set of simulations has been carried out using an open source object-oriented particle-in-cell code (XOOPIC).

Design and installation of a compact cylindrical IECF device: A compact version of the cylindrical IECF device having a diameter of 30 cm and a height of 30 cm has been designed and installed with the goal of achieving more NPR. The compact device incorporates a solenoid magnetic field along with electrostatic to achieve more ion compression within a small region thereby resulting in an increased fusion rate for an applied cathode voltage of around 80-100 kV. After installation of the device, an enamelled copper wire having a 2 mm diameter is wound around the two grooves with 100 turns in each groove. Initially, simulations have been performed to compute the electrostatic potential and magnetic flux density in the newly installed chamber using the COMSOL multi-physics software. A magnetic flux density of 20-30 Gauss has been observed in the central region when a coil current of 5A is maintained.

A.2.11 System for Microwave Plasma Experiment (SYMPLE) Device

Drawing analogy from Laser-Plasma interaction theories, fractional absorption of microwave in plasma has been theoretically estimated for various "effective angles" of incidence "θ_{eff}" in case of microwave – plasma interaction. Here, θ_{eff} is the relative permittivity of the plasma corresponding to the location from where the axially incident TM – mode microwave returns. Figure A.2.22 shows theoretical curves generated for the proposed study on fractional absorption of microwave in plasma, for waves incident at various θ_{eff} and, for various conditions of plasma density gradient scale length, $Ln = \lambda_g$ (solid curve at center), $Ln = 2\,\lambda_g$ (Dotted curve, left) and $Ln = 0.4\,\lambda_g$ (dotted curve, right); where λ_g represent the guided wavelength of the microwave.

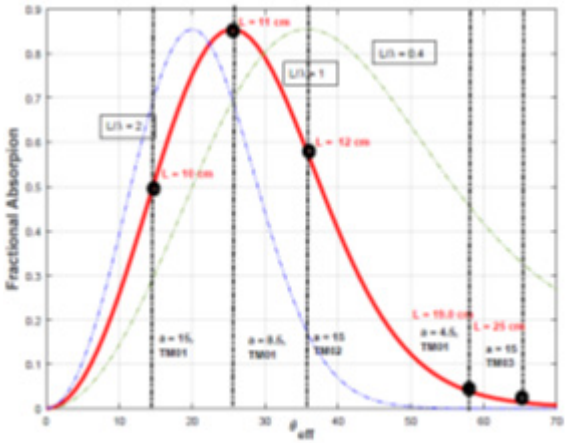

Figure A.2.22: Theoretically estimated absorption of microwave in plasma vs $\theta_{eff.}$

The effective angle of incidence has critical dependence on the microwave mode as well as the radial extent of the plasma column. Thus, investigating the fractional absorption vs θ_{eff} translates to studying interaction of microwaves of different modes with plasmas having different radial extents.

In order to accomplish experimental validation of the above referred wave absorption curve, different experimental set-ups have been made to enable interaction of different wave modes (TM_{01}, TM_{02}, TM_{03} etc.) with plasma columns having radial extent with 100 mm, 200 mm and 300 mm radial extents. Figure A.2.23 shows a photograph of HPM – plasma coupling set-up with the 3 MW, 3 GHz pulsed magnetron source coupled to a 100 mm plasma column.

Figure A.2.23: HPM – plasma coupling set-up with the 3 MW, 3 GHz pulsed magnetron source coupled to a 100 mm plasma column.

A.2.12 Helicon Plasma System (HeliPS) Laboratory

In a recent experiment, the effects of an externally applied magnetic field (0-300 G) on the mode transition of plasma density in the radial and axial direction have been studied in nitrogen RF discharge with the help of an RF compensated Langmuir probe (LP) and Optical Emission Spectroscopy (OES). The studies have been performed for different plasma parameters such as electron density, temperature, etc. Data collected from LP show all three mode transitions (E, H, and W mode) in presence of magnetic fields whereas for no magnetic field only two modes (E and H) are visible. An important inference from this study is that in the absence of a magnetic field, the dissociation of nitrogen molecules or the production of atomic nitrogen attains a relatively large value. This observation is useful in those plasma chemical processes where the higher concentration of atomic nitrogen plays an important role such as semiconductor etching, surface modifications, nitride film deposition etc.

A.2.13 Double Plasma Device Laboratory

In a recent experiment in the Double Plasma Device (DPD), five tungsten filaments of diameter 1×10^{-4} m are placed in the target cage to assist in the increase in the density of plasma in the target region. The electrons from the target filament should have a temperature $\leq$ 1 eV, so that it can form dissociative attachment with the vibrationally excited hydrogen molecule that diffuses from the source region and hence increase the density of the negative ions. A small accelerating voltage ~10 V is applied between the filament and the target cage, to enable electrons to escape from the filament space-charge zone, but not enough energy to ionize the neutral gas atoms that have diffused from the source region. Introduction of an electron source in the target region together with application of an accelerating voltage along with biasing voltage further increased the density of low energy electrons to 10^{17} m^{-3}. Thus, by utilizing these cage biasing techniques and additional electron emission, it has been possible to create more favourable conditions for negative ion formation and corresponding density increased from 10^{13} m^{-3} to 10^{16} m^{-3}.

A.3 Tokamak Experiments

Standard discharges of plasma current of ~ 100 kA, duration 300 ms at toroidal magnetic field of ~1.2 T were achieved in ADITYA-U. Many new diagnostics systems were also commissioned in ADITYA-U including the soft x-ray crystal spectrometer, fast reciprocating drive system and laser heated emissive probe system. In SST-1, a new 1.5 MW ICRH system was commissioned.

A.3.1 ADITYA-Upgrade Tokamak

ADITYA Upgrade Operations: After completion of preliminary plasma shaping experiments by charging the upper and lower diverter coils in ADITYA-U, a major vessel opening task was carried out. This has facilitated the removal of Langmuir probes garland, the old Thomson scattering system and Normal Incidence Monochromator (NIM) system and installation of multiple diagnostics systems such as crystal spectrometer, laser heated emissive probe, fast reciprocating Langmuir probe, and one diverter tile segment (4 nos. of upper and 4 nos. of lower diverter tiles with flush Langmuir probes). A tungsten coated graphite tile has been installed at the inboard side limiter. Furthermore, a new programmable trigger system hardware and GUI have been installed as well as an upgrade to the real-time horizontal plasma position controller has been implemented. This allows GUI-based variable set-points and propositional gain factor at different time-intervals. Standard discharges of Plasma current (I_p) ~ 100 kA, duration 100-200 ms at toroidal magnetic field (B_T) ~1.07T has been achieved within just 4 days of operation. Later, the discharge duration was enhanced to ~300 ms by using extensive wall conditioning and enhancement of Volt-sec using negative converter operation at a toroidal magnetic field (B_T) of ~1.2 T.

Role of MHD activity in sawtooth-induced heat pulse propagation in ADITYA: Studies in other tokamaks have shown sawtooth-induced heat pulse propagation to be faster, with electron heat diffusivity χ_e^{hp}, enhanced by a factor of 2.5 to 15 as compared to that estimated from the power balance, χ_e^{pb}. A reliable explanation for this is still not available. In ADITYA-U tokamak, fast propagation of sawtooth induced heat pulse from core to edge region is observed. Time-lags of 50 – 200 μs have also been observed in many plasma discharges with strong MHD activity. Figure A.3.1 (a) shows an inverted sawtooth in H_α signal corresponding to sawtooth crash in SXR in presence of MHD activity. SVD analysis shows presence of m/n = 2/1 & 3/1 modes. Figure A.3.1 (b) shows, that inverted sawtooth in the H_α signal ceases to appear in absence of MHD activity.

In order to track the transient electron heat pulse, ECE measurements have been carried out at different radial locations, (Fig. A.3.2 (a)). The estimated effective electron heat diffusivity is found to be χ_e^{hp} ~ 50 - 60 m^2/s for plasma discharge with relatively strong MHD activity, as compared to 35 - 40 m^2/s when MHD activity is weak. This result clearly indicates influence of MHD activity on electron heat transport.

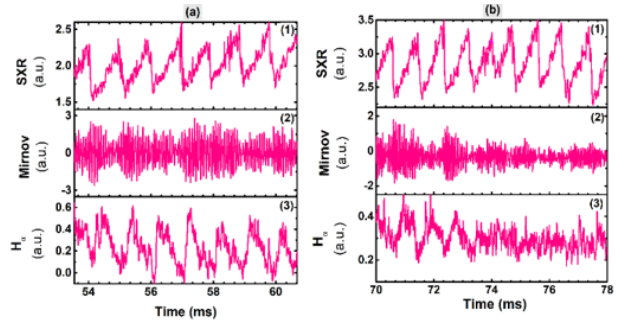

Figure A.3.1: Sawtooth in SXR and H_α signal for different amplitude of Mirnov oscillations, (a) relatively strong MHD (shot#13262&14139) (b) relatively weak MHD (shot#14176).

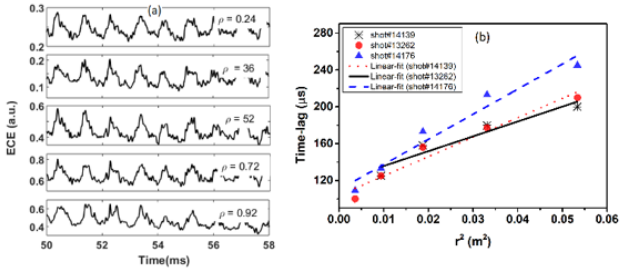

Figure A.3.2: (a) Sawtooth pulse observed in ECE signal at different spatial location for shot#13262. (b) Time lag between successive ECE channels t_p v/s r^2 plot obtained from ECE measurements for discharges with relatively strong MHD.

<u>*Observation of Geodesic Acoustic Modes (GAM) in ADITYA-U tokamak:*</u> Signatures of coupling between MHD oscillations and fluctuations in edge density (ne) and floating potential (V_f) have been observed in ADITYA-U tokamak (Fig. A.3.3). To study this coupling and its effect on turbulence and transport, several sets of Langmuir probes have been installed but separated toroidally and poloidally. Systematic analysis of a large discharge database (~100) shows that that such coherent edge fluctuations are triggered by MHD modes. The results indicate that the MHD oscillations might be the origin of GAMs in ADITYA-U tokamak. The observations are new to the field and have been observed for the first time in any tokamak.

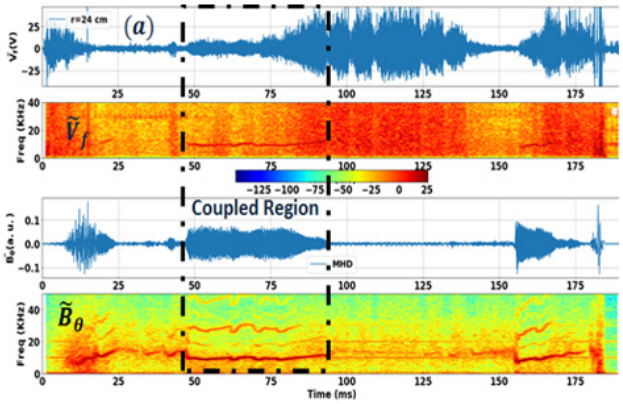

Figure A.3.3: (a) Similar freq. f~10kHz is observed in spectrogram of (V_f) and (B_θ).

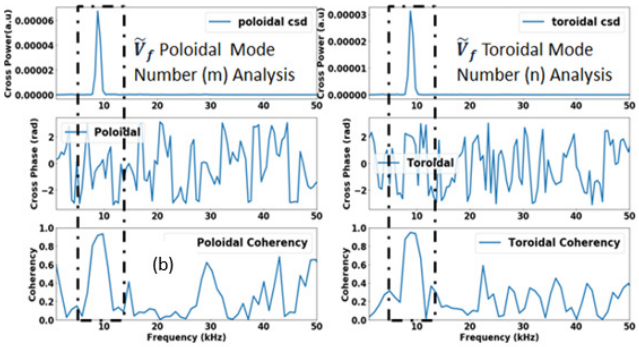

Figure A.3.3: (b) Poloidal and toroidal mode number analysis m=0.07 and n=0.68 for Shot 35912 for (V_f) ~ similar to theoretical values of m=0 & n=0 for GAM.

<u>*Design and operation of fast reciprocating drive system:*</u> A new indigenous fast reciprocating drive system (FRDS) for probes has been is installed in ADITYA-U for radial profile measurement of density (n_{edge}) and temperature (T_{edge}) with high spatial and temporal resolution (Fig. A.3.4). Speed and distance to be travelled can be pre-programmed, and can also be varied on a shot-to-shot basis. Data

from these probes can provide significant insight into edge density and temperature profile as well as radial electric field (E_r). This can help us understand physical phenomenon such as nature of turbulence, radial structure of zonal flows, effect of gas puff and supersonic molecular beam injection (SMBI) on edge parameters and their fluctuations.

Figure A.3.4: A view of Fast Reciprocating Drive System (FRDS).

Dust injector installed in ADITYA-U tokamak: Deposition of low *Z* material on the first wall of a Tokamak significantly reduces radiative losses. Techniques like Boronization and Lithiumization are used to deposit a thin film of Boron/Lithium on plasma-facing surfaces. Li dust injection, ICRF Boronization, Boronization using diborane, and Lithium rod heating for Lithiumization are a few of the means used for this purpose. Due to the poisonous nature of Diborane, it becomes necessary to use special equipment for safety. For safe Boronization, a novel dust injector has been designed for ADITYA-U using the vertical magnetic field as an aid to the system. Preliminary experiments have been carried out. This injector will also allow studies of impurity-induced turbulence suppression and transport.

Design, development, commissioning and operation of the tangential X-ray Crystal Spectrometer (XCS) on ADITYA-U Tokamak: A new soft X-ray Crystal Spectrometer (XCS) has been designed, developed & installed to provide experimental measurements of plasma rotation, ion temperature, electron temperature and study impurity transport. The spectrometer comprises of a cylindrically bent Silicon (111) crystal and a CCD detector to provide measurement of the resonance and satellite line emissions from He-like argon, $Ar16^+$ in the wavelength region of 3.94 – 4.0 Å from the plasma core. The engineering design of the spectrometer has been optimized to address all issues related to port geometry, machine accessibility, adjacent diagnostics etc. After successful lab testing, the optically aligned XCS spectrometer is now fully commissioned on ADITYA-U. Operation during plasma shots has shown preliminary signatures of $Ar16^+$ line emission from the plasma during argon gas puffing experiments.

Argon impurity transport in ADITYA-U using spectroscopy: Argon is envisaged to be a crucial candidate for future tokamaks to provide radiative power dissipation by reducing heat load on divertor plates through fine control and compatibility with plasma confinements. In this context, experiments with trace argon impurity injection have been performed for the first time in ADITYA-U tokamak to understand argon impurity transport using high resolution spectroscopic diagnostics which measures various line emissions in the visible and VUV region. Using a recently upgraded high resolution multi-track visible spectroscopic diagnostic, spatial profile of $Ar1^+$ line emissions has been observed in ADITYA-U plasma. The system consists of a 1.0 m f/8.7 Czerny – Turner spectrometer with a grating of 1800 grooves coupled with a CCD detector. All the observed line emissions of $Ar1^+$ ions have been identified using National Institute of Standard and Technology (NIST) database. Moreover, $Ar13^+$ and $Ar14^+$ line emissions at 18.796 nm and 22.115 nm respectively have also been observed using VUV spectrometer coupled with a CCD de-

tector. From these measurements, argon transport through the estimation of the diffusion coefficient and convective velocity has been investigated by comparing the radial profile of $Ar1^+$ emission obtained by inverting the line-integrated $Ar1^+$ data, with those simulated using 1D impurity transport code. Together with this, line ratio of $Ar13^+$ and $Ar14^+$ emissions have also been used to estimate transport parameters. This study will be further extended in future to include results obtained from x-ray crystal spectrometer.

Laser Heated Emissive Probe (LHEP) diagnostic system on ADITYA-U: A radially movable 2-probe Laser Heated Emissive Probe (LHEP) diagnostic system was installed on ADITYA-U, with an aim to study plasma potential and its fluctuations in the edge region, after carrying out a series of both in-situ and in lab experimental iterations. Mechanical structure to support LHEP laser was conceptualized, designed and developed in ADITYA-U having a noteworthy feature of continuous focusing laser beam onto probe surface despite the system's radial movement.

Study of sawtooth instability with gas pulse injection: It is observed that the sawtooth oscillation period in ADITYA-U Tokamak increases after injection of short pulses of gas, containing 10^{17}-10^{18} molecules of hydrogen. Maximum increase in period of sawtooth is 1-1.8 ms after each gas pulse injection. It is observed that the increase in the sawtooth period depends on the ratio of the core to edge electron density. After a long sawtooth, period of subsequent sawtooths gradually decreases until the next gas pulse is injected. This may be because of modification of current density profile by the short gas pulse injection which changes the local shear near the q=1 surface and stabilises the internal kink mode.

Unipolar and bipolar electrode bias experiment: Applying a high bias voltage, around or larger than plasma potential, and drawing a large current (~100-300 Amp) from the flux surfaces by an electrode generates an inhomogeneous electric field in the edge region of the tokamak. The sheared radial electric field is responsible for sheared poloidal flow. In ADITYA-U, a dedicated electrode bias experiment has been carried out to understand the above phenomenon. Alternative positive and negative pulses are applied by employing the in-house developed IGBT-based capacitor bank power supply. The experiment has been carried out in a wide range of biasing frequency from 20 Hz to 15 kHz and the maximum voltage applied to the electrode is 400 V. A long-distance coherence mode is confirmed to be zonal flow during biasing improved confinement mode. This study is crucial to understand the role of the sheared radial electric field along with the zonal flows (ZFs) on the suppression of turbulence and hence on modification of transport.

Spatial mapping of low pressure cluster jets using Rayleigh scattering: A high resolution and sensitive Rayleigh scattering based experimental set-up is designed to study the evolution of atomic clusters in a highly under-expanded supersonic jet of Argon. As a result of the high resolution and sensitivity, the measurement range is extended from a few nozzle diameters to 50 nozzle diameters. This paves the way to track the growth of clusters along the flow direction experimentally, which was previously limited to few nozzle diameters.

The 2D profiles of the distribution of clusters inside the jet were generated. The results (Fig. A.3.5) show that the spatial distribution of clusters inside the supersonic core deviates considerably from the prediction of the free expansion model. This is used to estimate the cluster growth along the expansion

direction. An enhancement in cluster along the expansion direction continues up to a certain distance after which it eventually saturates. This enhancement may justify the cause of disagreement in size predictions of cluster from different experiments reported earlier.

The profile of the clusters at the jet boundaries (Fig. A.3.6) indicates complete disintegration of cluster at the normal shock due to the shock temperature higher than condensation limit of argon. On the contrary, clusters exist at barrel shock resulting in increased density, which could be due to flow temperature remaining lower than the condensation limit in the region between the inner weak shock and the outer strong shock.

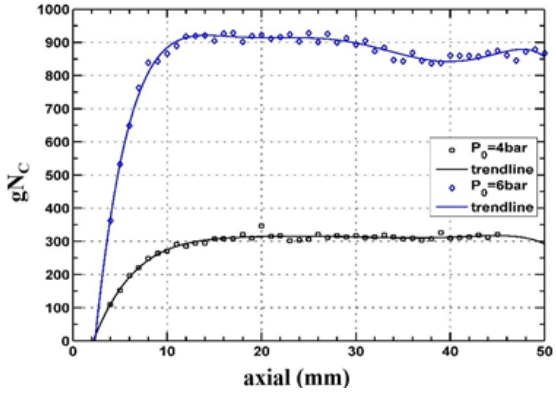

Figure A.3.5: Variation of product of liquid mass fraction (g) and cluster size (NC) along the axis of jet for two different nozzle pressure.

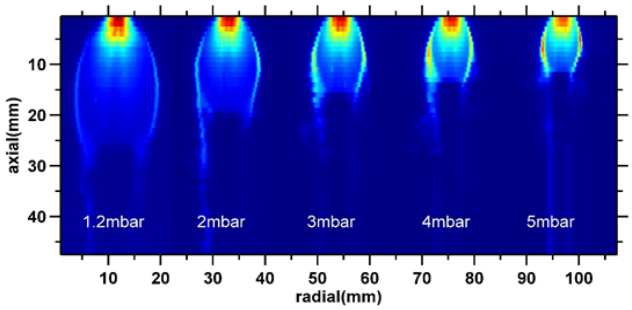

Figure A.3.6: Rayleigh Scattering from the clusters present in the jet operating at five different values of background pressures and same nozzle pressure (4 bar).

A.3.2 Steadystate Superconducting Tokamak -1 (SST - 1)

In SST-1, plasma current of 65 kA for the duration of 650 ms with density 8 x 10^{12} cm^{-3} and temperature 250 eV has been demonstrated. In order to enhance the plasma density & temperature, attempts are underway for the injection of Inductively-driven Pellets of Micro-granules of Lithium Titanate (Li_2TiO_3) powder at a velocity ~ 200m/s. A 36-65 MHz and 1.5 MW Ion Cyclotron Resonance Heating (ICRH) has been integrated and commissioned. In addition integration of hardware in loop Plasma control system (PCS), simulation model for vertical field power supply, linear plasma model simulation, removal of Plasma Facing Components (PFCs), insitu magnetic field mapping, and installation of In-vessel PF#6 and new VF coils are under implementation.

Hardware in loop for integrated plasma control system: The Hardware-in-Loop (HIL) involves operation of various subsystems in a closed loop. The schematic of closed loop PCs is shown in figure A.3.7.

a) Vertical Field Power Supply (VFPS) model simulation: MATLAB Simulink based model for VFPS has been implemented, which generates required coil current profile based on plasma current profile. The model has been rigorously tested & validated with previous experimental data (within the error tolerance less than 5%) and is under implementation with the hardware so as to be available in the upcoming experimental campaign.

b) Linear plasma model simulation: Electrical circuit model of the whole tokamak device has been developed. It is being validated against the previous experimental data. Plasma physical parameters and their dynamics are also being incorporated so

that it can model the plasma breakdown, current startup and its evolution as observed in the previous experiments.

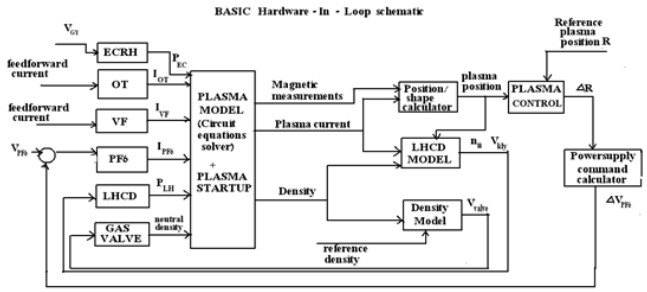

Figure A.3.7: Schematic of HIL.

Temporary removal of Plasma Facing Component (PFC) in SST-1: Plasma facing modules were installed earlier for shaped plasma operation in SST-1, Since PF coils cannot be used in SST-1 at the moment due to cryogenic load issues, and shaped plasma cannot be produced, the PFCs are currently redundant. In order to improve diagnostic access to the plasma, a large number of Plasma Facing Components (PFCs) have been temporarily removed (Fig. A.3.8) for following reasons:

• Significant vacuum leaks (7.0 X 10^{-3} mBar l/s) have been observed between cryostat & vessel. PFCs were preventing access to the leak. After removal, leak rate has been reduced below 1.0 X 10^{-8} mBar l/s.

• PFC removal will minimize influx of carbon from graphite tiles during shots.

• With PFCs, it was difficult to install sets of in-vessel coils which were needed to provide a long duration plasma with equilibrium and control.

The PFCs will be reinstalled when shaped plasma operation again becomes possible.

The 29th experimental campaign was the first campaign after the PFC removal; and also after a long break used for fixing up the vacuum vessel leaks. During this campaign, cryo-stable TF magnet operation at 1.5T flattop has been achieved for more than 8 hrs.

The highlights of this campaign are as follows:

1) Vessel and cryostat pressures were maintained at $5x10^{-7}$ and $3x10^{-5}$ mBar.

2) The experiments were performed at a toroidal field of 1.5T with the required OT-VF profiles.

3) The Operation and APPS teams have made the Hardware-in-loop simulations to estimate & launch the VF profile (based on the previous shot information) and that has been tested successfully.

4) This time, consistent operations of ECR, APPS and a few shots with LHCD were done. 100+ discharges with max plasma current of 55kA and duration of 200ms has been obtained. ICRH was not used during these shots.

5) Interesting ECR pre-ionization discharge patterns and their dynamics, captured in the fast imaging camera. The same are being analyzed in detail.

6) Diagnostics data showed the presence of impurities dominated by C and O. Wall conditioning would be continued.

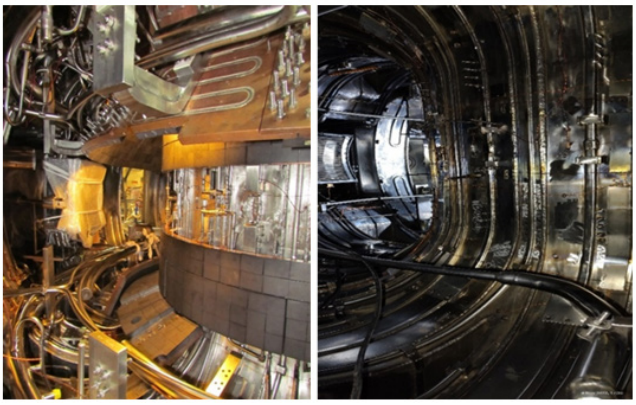

Figure A.3.8: Inside view of SST-1 vacuum vessel before and after PFCs removal.

New high power ICRH system for SST-1 (1.5 MW, 36 – 65 MHz): An indigenously-developed R&D program has yielded a Tetrode-based 1.5 MW RF source with significant indigenous content (except

for the vacuum tube), figure A.3.9. The entire system was shifted to the SST-1 Hall and re-installed along with required power supplies, water cooling and interconnecting transmission line components. As a part of installation all the control cables have been laid down and handshaking between LCU and various subsystems has been completed followed by successful commissioning of the RF source in the SST-1 hall. The systems is operational remotely through LCU, figure A.3.10.

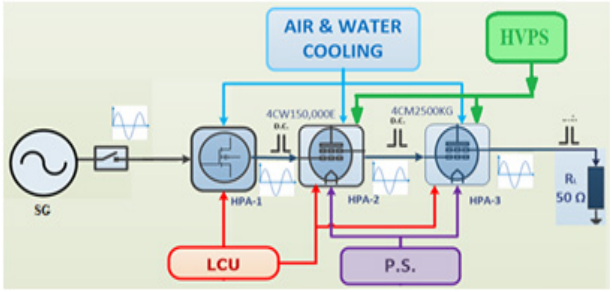

Figure A.3.9: Scheme of 1.5MW RF Source.

Figure A.3.10: View of Installed RF source in SST-1 hall.

A.3.3 Tokamak Diagnostics

Indigenously developed real time heterodyne interferometer system for ADITYA-U: An indigenously designed, developed, and characterized 100 GHz Heterodyne interferometer system has started providing real-time plasma density measurement. The system has the sensitivity or the noise floor - 69 dBm and dynamic range -65dBm to -10dBm.

Figure A.3.11: Schematic block diagram and 100 GHz heterodyne system.

A new FPGA based density controlled gas injection system has been developed and installed in ADITYA-U. The system (Fig. A.3.11) is used for density feedback to achieve better quality discharges. The developed real-time density control system is able to maintain the line integrated plasma density at the desired level.

'Made in India' visible spectrometer on ADITYA-U: Till date, visible spectrometers used for plasma diagnostics have all been foreign brands. For the first time, a 0.5 m visible spectrometer, made in India by a an Indian optical component manufacturing company in collaboration with the institute, has been procured and installed on ADITYA-U to monitor visible emissions (Fig. A.3.12). The spectrometer has three gratings with groove densities of 300, 600 and 1200 grooves/mm and the detector is a linear CCD array having 3648 pixels with single

pixel size of 200 µm x 8 µm. The reciprocal linear dispersion of the spectrometer is 1.47 nm/mm with 1200 grooves/mm grating. The spectrometer supplied with software, has all the required features for setting and control of the spectrometer and also spectrum acquiring capabilities with exposure time setting and background correction.

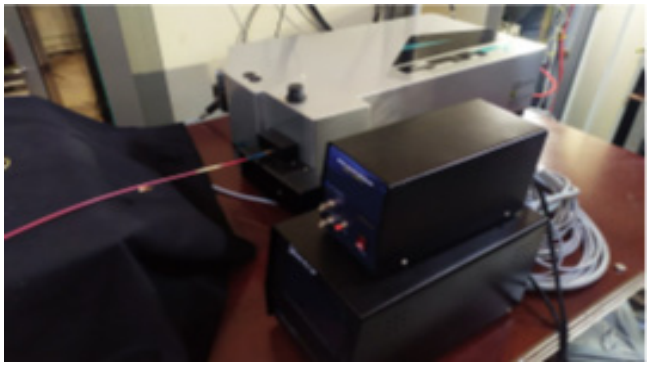

Figure A.3.12: Visible spectrometer developed at the institute for ADITYA-U tokamak.

The detector is placed on a computer controlled opto-mechnical platform for easy movement and alignment. It is now in regular operation and is acquiring data during ADITYA-U shots. The performance of this spectrometer is comparable to the results obtained by foreign brands. This development is an important step towards "Aatmanirbhar Bharat".

Recent progress on the development of Magneto-Optic Current Sensor diagnostic for plasma current measurement in ADITYA-U tokamak: A plasma diagnostic system, Magneto-optic Current Sensor (MOCS) also known as Fiber Optic Current Sensor (FOCS) is being developed for plasma current measurement in the ADITYA-Upgrade tokamak. The diagnostic measurement technique is based on the principle of the Faraday effect. It provides redundant measurements of plasma current for cross-comparison and validation with the conventional Rogowski coil. Inherent presence of linear birefringence in the single mode optical fiber as well as additional birefringence introduced because of curvatures and stress/pressure while setting up the MOCS optical fiber layout around the tokamak vacuum vessel leads to an underestimation of the actual plasma current. To counter this, recently the diagnostic system is equipped with the onsite calibration technique (Fig. A.3.13) for reliable estimation of the plasma current and to determine calibration factors.

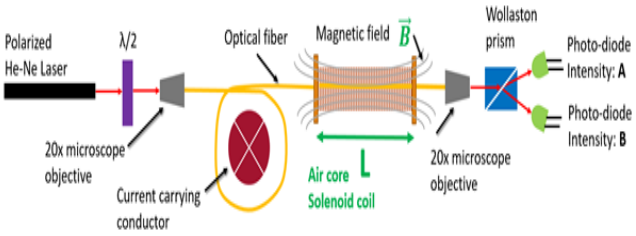

Figure A.3.13: Schematic of the MOCS calibration system.

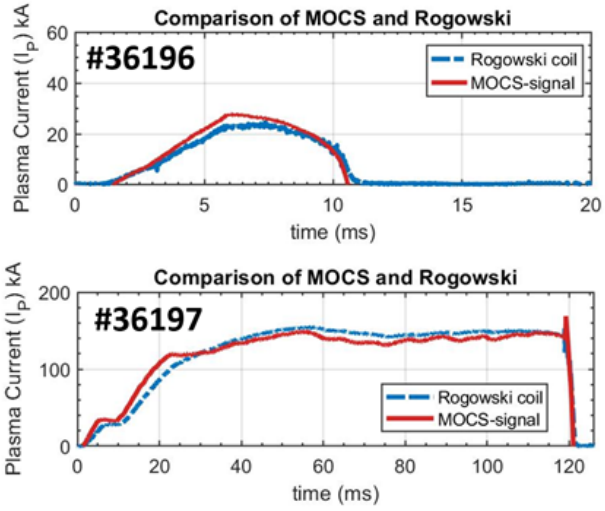

Figure A.3.14: Plasma current measurements using MOCS diagnostic setup installed on the ADITYA-Upgrade tokamak and comparison of its measurements with Rogowski coil.

The onsite calibration technique has been validated by measuring known current passing through the busbar of the Toroidal Field (TF) coil in ADITYA-Upgrade tokamak. Using this MOCS-setup, plasma current measurements up to ~150 kA were recorded as shown in figure A.3.14 for ADITYA-U tokamak. A comparison of the MOCS measurements with the Rogowski coil shows a reasonable and consistent agreement within ±15%.

Study of the Advanced Hard X-ray Shielding design for Tokamak Hard X-ray Diagnostic: The x-ray emission which is greater than 100 keV from the tokamak is referred to as hard x-ray (HX) emission, and it emanates due to runaway electrons (RE). RE is a small fraction of the total plasma electron population carrying an enormous amount of energy. RE when interacting in the wall or the limiter emits HX due to the retardation which have energy up to MeV. The Hard x-ray emission is measured by high-density detectors like $LaBr_3$ (Ce) scintillation based detector.

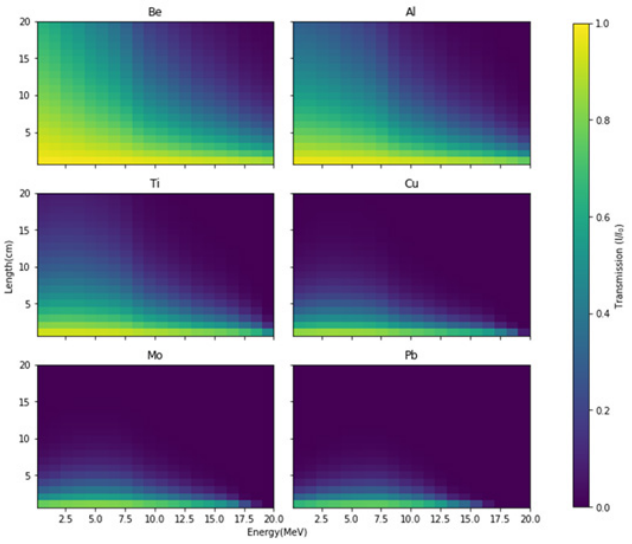

Figure A.3.15: Elemental analysis for a range of predefined hard X-ray (100 keV – 20 MeV).

For the detector, there is requirement of shield so that the photon detector interaction can be unidirectional and the HX photon can experience the maximum detector material length. Study of detector shielding strategy was done in terms of shield material as well as the shield design with the goal of replacing traditional shield made of lead, with composite materials with similar shielding properties, but lighter, more easily formed, and workable, with lower impact on the environment and reduced toxicity for human health. Different combination using Pb/Al/Mo/Ti/Cu/Teflon/Mylar were studied using calculations done with Python 3.1 version to design an advanced HX shield for the detector at different incident energy flux (> 100keV). The transmittance through different elements was analysed by keeping the parameters like length of material and energy of incident radiation as fixed. Since beryllium was found to be excessively transmitting incident photons (Fig. A.3.15), it was excluded from further calculations.

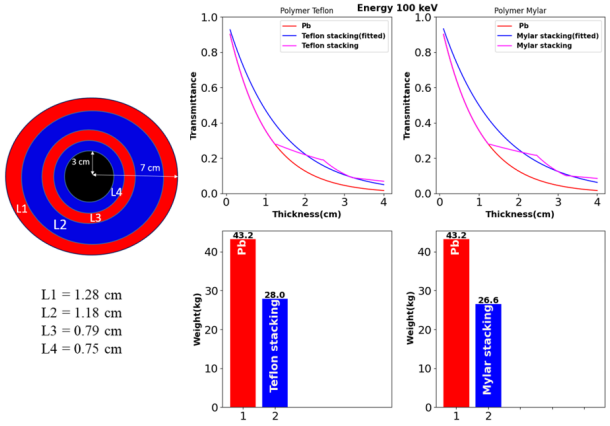

Figure A.3.16: Schematic of proposed shield along with study of transmittance with shield length and reduction in weight using composite of polymer and lead.

Other elements like Cu, Ti, Al, Mo, Pb were studied by forming multi-layered stacked structure for shielding. A combination of lead (Pb) and polymer

(Teflon/Mylar) is seen to exhibit significant reduction of about (30 -35)% through calculations while achieving transmittance similar to traditionally used Pb shielding of 4 cm thickness (Fig. A.3.16).

Electron Cyclotron Emission (ECE) Radiometer diagnostic observes the Pitch Angle Scattering (PAS) events at ADITYA-U tokamak: For the first time at ADITYA-U tokamak, the 16-channel ECE radiometer diagnostic has recorded and examined a sharp increase in the ECE signal amplitude that was followed by sporadic step like modulations for the low density plasma discharges. Due to the newly developed radiometer system's broadband measurements, high dynamic range & high temporal resolution, it was feasible to detect this steep rise. The broadband ECE radiometer at ADITYA-U is a 16-channel super-heterodyne receiver system covering a wide second harmonic frequency range of 64 – 83 GHz in the X-mode. The designed system provides a spatial resolution of 1.2 cm and a temporal resolution of 10μs. These measurements accompanied with fast temporal resolution of the designed diagnostic is advantageous for the investigation of kinetic instabilities like PAS that have a rise time of ~100μs.

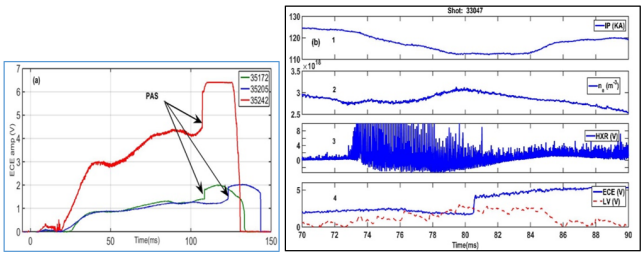

Figure A.3.17: (a) Steep Rise in ECE amplitude signifying the PAS events (b) temporal evolution of: (1) plasma current (IP), (2) density (n_e), (3) Hard X-Rays (HXR) and (4) Loop Voltage (LV) & ECE amplitude.

A glimpse of the PAS events can be seen as a steep jump in central ECE radiometer signals for 3 different discharges as depicted in figure A.3.17 (a). Figure A.3.17 (b) depicts the temporal evolution of few plasma parameters like plasma current, chord averaged density, Hard X-ray (HXR) amplitude and ECE amplitude (showing the steep rise) along with the loop voltage data. The possible reason for this abrupt jump in ECE signatures is attributed to the Pitch Angle Scattering. Anisotropy of the electron distribution function leads to the excitation of various instabilities like fan instability. This results in the generation of many low frequency waves within the ion cyclotron frequency range. Interaction of these waves with the RE's leads to the Anomalous Doppler resonance (ADR) effect. A consequence of this effect is the pitch angle scattering of runaway electrons. The experimentally observed critical condition for ADR occurrence is that the ratio of electron plasma frequency to electron cyclotron frequency $\omega_{pe}/\omega_{ce} < 0.3$-$0.6$ similar to those observed in EAST, TEXTOR, HT-7, and KSTAR etc. A consequence of this effect is the conversion of longitudinal velocity of RE's into transverse velocity which in turn leads to decrease in RE energy due to enhancement of radiation losses at larger pitch angles.

Investigation of temporal evolution of hard X-ray spectrum from neon-seeded plasma of ADITYA-U tokamak: The adverse effect associated with runaway electrons (RE) requires the temporal monitoring of the hard x-ray (HXR) spectrum produced by RE. This enables knowledge related to the photon flux corresponding to a particular energy of HXR in temporal space. A lanthanum bromide ($LaBr_3$)-based HXR spectrometer system (80 keV~5 MeV) is routinely operated on the ADITYA-U tokamak for the temporal evolution of the HXR spectrum. The temporal evolution of the HXR energy having maximum count and the average RE temperature (RE average energy) (Fig. A.3.18) has been ana-

lyzed for the plasmas injected with neon (Ne) impurity.

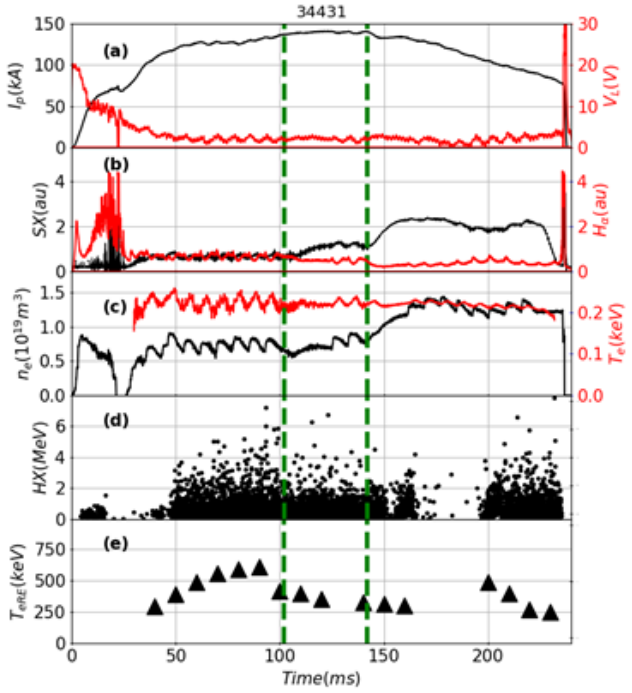

Figure A.3.18: The temporal evolution of (a) plasma current (I_p) and loop voltage (V_L), (b) soft X-ray (S_X) and neutral hydrogen emission (H_α), (c) electron density (n_e) and temperature (T_e), (d) Hard X-ray (H_X) and (e) average RE temperature (T_{RE}) for an ADITYA-U discharge.

It is found that peak energy and average runaway energy reduce significantly after the Ne gas puff and the reduction happens when the electron density rises after the Ne gas puff. The RE temperature values are ~ 620 KeV and 230 KeV before and after the Ne injection, respectively. After the Ne gas puffing, spectral shape, in both counts and energy shrunk drastically which suggests the reduction of the HXR emission from the plasma.

Observation of tearing modes in Bolometer signals in ADITYA-U: Bolometer diagnostics in ADITYA-U comprises of three pin-hole cameras mounted on radial and top ports respectively. Both linear arrays and 2-pi bolometers are used for the total power radiation loss and radiation brightness measurements. Upgrade in the detector system and the electronics has enabled the recording of fast events (up to 10 kHz) and resulted in the observation of tearing modes in data from ADITYA-U tokamak for the first time. The poloidal and toroidal tearing modes rotate with frequencies of kHz order and are detected using mirnov coils. Since the rotating modes interact with the background plasma and modulate the pressure, the presence of modes is also observed in radiation power loss data when these are different than the background plasma. Figure A.3.19 shows the spectrogram from one of the mirnov coils and array channel. The frequency modulation (10 kHz to 7.8 kHz) due to a train of hydrogen gas puffs in the plasma is captured in the bolometer signal.

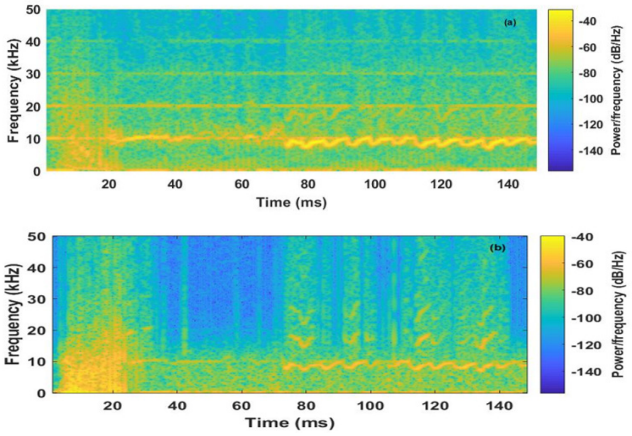

Figure A.3.19: (a) Spectrograms of the Mirnov coil and (b) Bolometer array channel.

A.4 Fusion & Related Technologies

Under the purview of continuous progress related to fusion science and technology, many technologies are being developed. A brief about the technologies developed under various heads are highlighted in the following subsections.

A.4.1 Magnet Technologies

Superconducting coils for high magnetic fields: As a continuous part of development on the superconducting coils, significant progress has been made towards low and high temperature superconducting (LTS and HTS) coil and conductor for high magnetic field generation. R&D on LTS conductor includes development of 14 kA Nb_3Sn Cable-In-Conduit Conductor (CICC) by the institute and Atomic Fuel Division (AFD) of BARC (Fig. A.4.1). A 100 m long Nb_3Sn Cable has been inserted inside a 6m long SS316LN conduit using pull through technique.

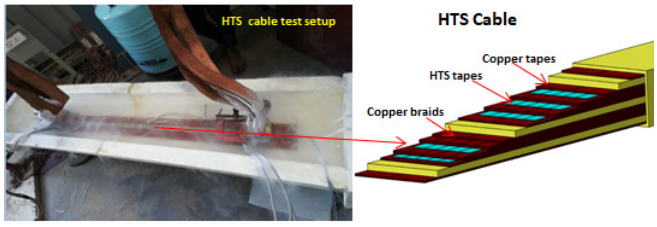

Figure A.4.1: 100 m long Nb_3Sn CICC and Development of superconducting coils for high magnetic fields under test conditions.

The conduit ends have then been joined through optimized orbital welding and final compaction, swaging and spooling have been achieved successfully. HTS developments include the fabrication and testing of a 1 Tesla conduction cooled solenoid magnet.

A.4.2 High Temperature Technologies

Studies on the retarded recrystallization of tungsten: Plasma exposed samples of tungsten (W) are characterized by optical and field emission scanning electron microscopy (FESEM) for Vickers surface microhardness and electron backscattered diffraction (EBSD) studies. The W sample plasma irradiated at the maximum temperature (WP1) is seen to undergo a retarded grain growth. The average grain size on the plasma exposed and opposite side as seen from the FESEM images is estimated as 7.05 μm and 20.37 μm respectively. EBSD studies estimate 34% fractional recrystallization of this sample. The FESEM micrographs also show local concentration of smaller grains ~ few micrometers (Fig. A.4.2a). Similarly very small grains are also seen on the fast ion beam (FIB) made cross sections

near the exposed surface, EBSD of which points to no recrystallization and remains in the initial deformed state (Fig. A.4.2b). However, a second sample plasma, WP2, exposed for a three times longer duration but at temperature which is 170K less than WP1 shows 93% recrystallization. It may be therfore be concluded that during simultaneous plasma exposure/annealing, the effect of retarded recrystallization may diminish very quickly with the increasing fluence.

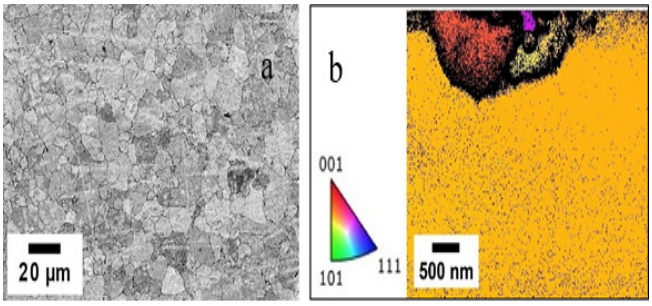

Figure A.4.2: FESM micrograph (a) shows the grain structures on the plasma exposed surface of WP1 (1866K), EBSD IPF map of the FIB made crossection of WP1 (b) shows small grains along the exposed surface which still remains deformed.

The sub-surface region of the plasma exposed sides of WP1 and WP2 are studied to understand the possible role played by the helium bubbles on the process of retardation, especially at very high temperature annealing conditions.

A.4.3 Fusion Blanket Technologies

Design and Development of high-pressure, high-temperature (8.0 MPa, 300 - 400 ºC) helium cooling system: The Experimental Helium Cooling (EHCL) System has been successfully commissioned and the facility has been operated at its nominal operating conditions (Pressure - 8.0 MPa, Temp. 300 ºC) using individual circulators having a flow rate ~ 0.2 kg/s flow rate. EHCL is a unique facility worldwide and one of its kind in India. This facility comprises of specialized components such as printed circuit type heat exchangers, high speed centrifugal circulator, electrical heaters etc. and has advance operational and control logic. The facility was inaugurated on 27 March 2023 by Shri K. N. Vyas, Chairman, Atomic Energy Commission (AEC) Secretary, Department of Atomic Energy (DAE), Govt. of India (Fig. A.4.3).

Figure A.4.3: Shri K. N. Vyas, Chairman, Atomic Energy Commission (AEC) Secretary, Department of Atomic Energy (DAE), Govt. of India.

This loop will simulate Helium cooling system for fusion blanket module and divertor components by providing experimental data on their mock-up. EHCL system will be integrated to High Heat Flux facility (Electron Beam) for testing of various mock-ups of plasma facing components. Fig. A.4.4 and Fig. A.4.5 show the 3-D layout and bird`s eye view of system and various major components & different activities of the installation, integration and testing.

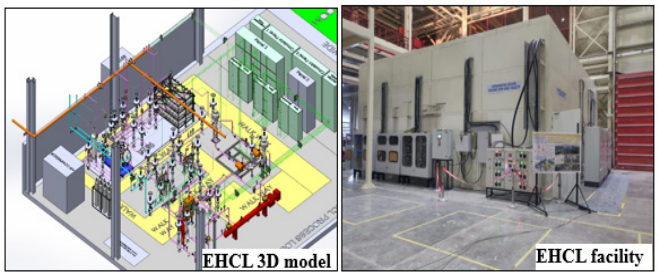

Figure A.4.4: 3-D layout and EHCL system at the institute.

Figure A.4.5: Major components of the EHCL system installed, integrated and tested at site.

<u>*Operational results of liquid Pb-Li MHD loop:*</u> The operation of Pb-Li MHD loop at the institute has started and is of interest for the design of India's Test Blanket Module. The MHD experiments conducted so far involve a test mock-up having 'U' shaped stainless steel circular flow geometry (Fig. A.4.6) with an ID of ~ 52.5 mm. In presence of ~1.06 T magnetic field the effective flow length is ~ 937 mm in the transverse magnetic field region. It is equipped with a large number of potential pins (71) welded on the surface, thermocouples (32 no.) and pressure measurement ports for estimation of important MHD parameters such as liquid metal pressure drop, temperature and velocity profile etc.

During the experiments, the loop is continuously operated at a temperature of ~350 °C and the flow rate of Pb-Li is varied between 2 to 8 kg/s. It is observed that for a given pump rotation frequency, the Pb-Li flow rate decreases linearly with increasing magnetic field. In the absence of magnetic field, the liquid metal pressure drop in the loop follows a quadratic relationship, as expected in normal hydrodynamic flow.

Figure A.4.6: Pb-Li MHD loop at the institute (left) and 'U' shaped circular cross-section test mock up inside the magnet pole gap (right).

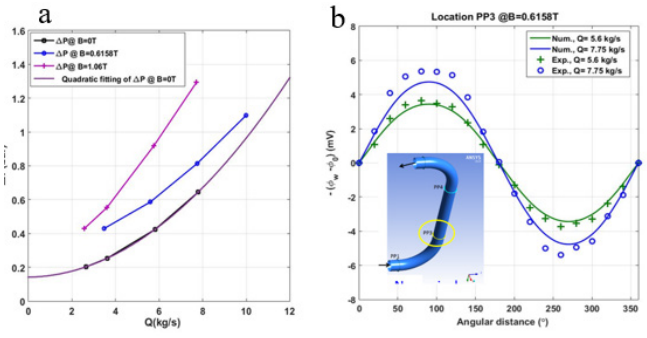

Figure A.4.7: Variation of experimentally measured Pb-Li pressure drop in the loop with flow rate for various magnetic field (a) and Angular distribution of wall electric potential at two different Pb-Li flow rates (B ~ 0.6 T) (b).

However, with increasing magnetic field, the pres-

sure drop starts to follow a linear relationship (Fig. A.4.7a), clearly indicating the effect of transverse magnetic field on the electrically conducting Pb-Li flow. At B~1.06T, the MHD pressure drop across the test mock-up is estimated to be ~0.65 bar at the Pb-Li flow rate of ~8 kg/s which is in good agreement with the value obtained from numerical MHD analysis. Additionally, a sinusoidal distribution of the wall electric potential has also been observed as shown in figure A.4.7b, which indicates the evolution of MHD affected liquid metal flow within the test mock up.

Measurement of sonic velocity in Pb-Li at high temperature: A technique has been developed to measure the sonic velocity of fluids at high temperature. The set up consists of a rectangular tank with a step block as shown in figure A.4.8. The step block provides three different widths of fluid for the measurement of sonic velocity. The tank is equipped with electrical heaters at its outside to control the fluid temperature and an inert cover gas is used at the top of the fluid to regulate fluid pressure. Ultrasonic transducers are mounted at the outer surface of the tank. Sophisticated electronics are used to measure the transmitted and reflected sonic waves. To determine the sonic velocity in the fluid, the setup relies on the width of the step block and the time taken between the transmitted and reflected wave. The technique has been applied to measure sonic velocity of water and iso-propyl alcohol at room temperature, achieving an accuracy < 4 %. Additionally, the sonic velocity of Pb-Li has been measured in temperature range of 285-375 °C, with accuracy < 6 % (Fig. A.4.9). It has been observed that Pb-Li poses a high attenuation to the sonic waves. An addition of tungsten plate as reflective surface increases the reflected sonic wave signal.

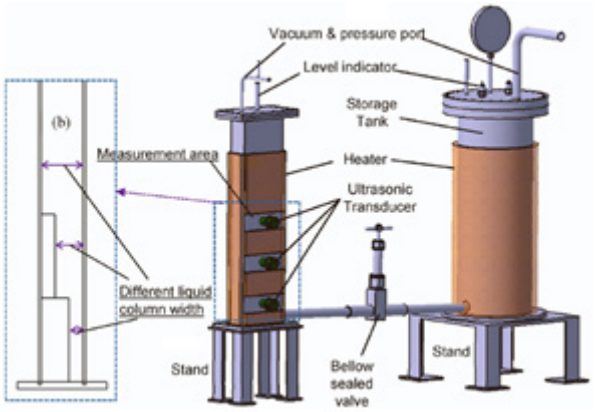

Figure A.4.8: Experimental set up for sonic velocity measurement of fluids at high temperature.

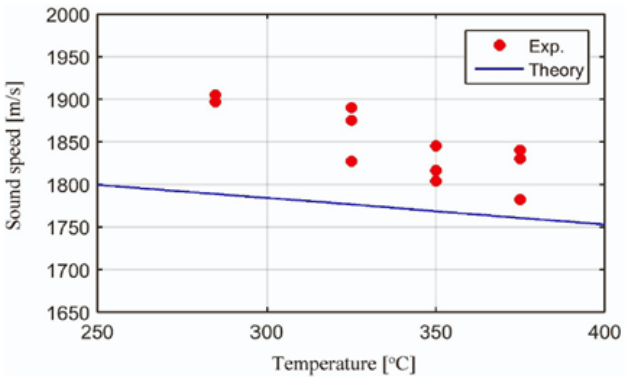

Figure A.4.9: Variation of sonic velocity of Pb-Li with temperature.

Development and testing of atmospheric molecular sieve bed and cryogenic molecular sieve bed: Hydrogen Isotope Removal System (HIRS) for tritium extraction by adsorption mass transfer mechanism has two major components: (1) Atmospheric Molecular Sieve Bed (AMSB) and (2) Cryogenic Molecular Sieve Bed (CMSB). AMSB removes ppm levels of tritiated water vapours, Q_2O (Q = H, D or T), while CMSB removes ppm levels of hydrogen isotopes, Q_2, along with oxygen and nitrogen gas from Helium purge gas. Development and performance assessment of lab scale AMSB and CMSB have been recently completed

at the institute (Fig. A.4.10a and A.4.10b). Absorption of moisture (H_2O) concentrations up to (~20,000 ppm) and flow rates (1-3 LPM) have been performed with zeolites 4A as an adsorbent material using the AMSB set-up. CMSB system has also been tested for the cryosorption of unary as well as binary mixture of 100 and 1000 ppm hydrogen & deuterium in helium gas with zeolites 5A and 13X as adsorbent materials. The separation and analysis of ppm levels of H_2 and D_2 in helium during breakthrough were performed using an in-house developed modified alumina column in Gas chromatography system. From this experimental activity, we have identified that in addition to zeolites 5A, which has been recommended till date by the fusion community as a potential adsorbent for CMSB, zeolite 13X also exhibits good isotopic selectivity and a longer breakthrough time.

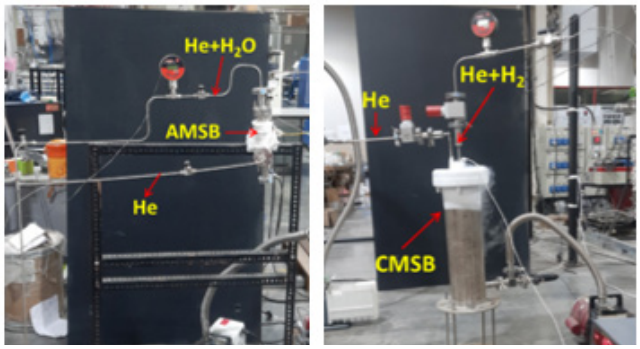

Figure A.4.10: (a) Lab scale AMSB Setup (b) CMSB Setup.

Hydrogen isotopes transport parameters (diffusivity and solubility) data generation for lead lithium (Pb-Li) eutectic alloy: Knowledge of the hydrogen isotopes mass transport parameters (Diffusivity, Solubility etc.) in Pb-Li is essential for the designing an effective tritium extraction system and determining the tritium permeation rate from the breeder to structure materials in fusion reactors. An experimental setup has been designed, integrated and made operational to perform experiments related to determining hydrogen isotope (hydrogen and deuterium) transport properties (diffusivity, solubility and permeability) for Pb-Li eutectic alloy using transient permeation method. The experimental setup (Fig. A.4.11) consists of solubility chamber with pure iron foil welded inside it and connected to Pb-Li melting tank. A known amount of liquid Pb-Li from melting tank is supplied to solubility chamber which rests on iron foil. One side of molten Pb-Li is pressurised with hydrogen/deuterium gas and the permeated gas on the other side of Pb-Li is detected using gas analyser. Solubility and diffusivity is obtained by fitting permeated gas flux with numerical solutions at various temperatures.

Figure A.4.11: Experimental setup for estimating hydrogen isotopes transport properties in liquid Pb-Li eutectic alloy.

Design and development of Hydrogen Isotopes Extraction System (HIES): Hydrogen Isotopes Extraction System (HIES) is designed and developed at the institute for extraction of hydrogen isotopes from liquid Pb-Li. The design mainly includes right selection of Pb-Li compatible structured packing

material, sizing of suitable gas liquid contactor (extractor column) and other process tanks. In the present set up a Sulzer make BX type structured material is used as packing material in the extractor column, figure A.4.12. HIES operation consists of hydrogen isotopes dissolution in liquid Pb-Li and their subsequent extraction. Extraction process is performed in extractor column which is the main component of HIES. The hydrogen isotope extraction from liquid Pb-Li is to be carried out at 350-450 ^{0}C using purge helium gas that flows in counter current direction at 1.2 – 1.5 bar pressure.

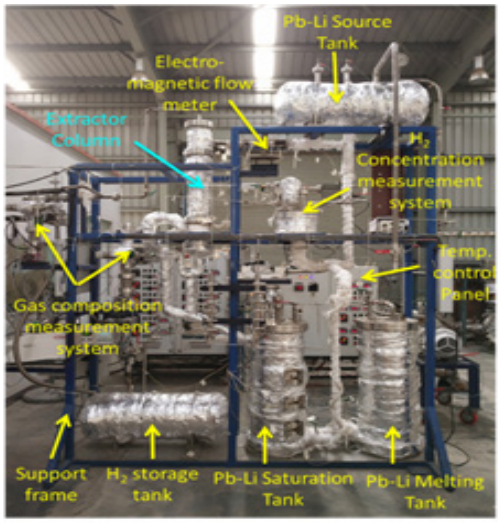

Figure A.4.12: Installed HIES set-up.

Integration of diagnostics for pressure, temperature, level, flow and concentration measurement and their inter connection with data acquisition and control system is completed. Major components and Pb-Li carrying pipes are covered with heaters and thermal insulation. Various pre-commissioning activities like heater testing, temperature, pressure and flow meters performance, pressure testing and leak testing have been performed. The heater performance is checked keeping the loop in the temperature range of 300-450 ^{0}C. The UHV compatible assembly is checked with helium leak detector to leak rates of ~10^{-8} mbar lit/s. The pressure testing is performed at 5 bars at both, the component as well as integrated level. HIES operation is initiated with melting of 575 kg of Pb-Li chunks and its dissolution with hydrogen gas via bubbling process. Preliminary measurement of dissolved hydrogen concentration in liquid Pb-Li is carried out with permeation based hydrogen sensor. Additionally, some experiments are carried out to check the performance of extractor column.

A.4.4 Large Volume Cryopump and Cryoplant Technologies

Installation of liquid nitrogen cooled cryopump on SST-1 tokamak: A liquid nitrogen cooled sorption cryopump (Fig. A.4.13) has been indigenously developed and deployed on the SST-1 Tokamak. It is capable of providing a pumping speed of 26,000 litres/s for water vapour and 3,000 l/s for nitrogen. A special feature is that it operates under the condition of high radiative heat load on the pump while baking of vacuum vessel.

Figure A.4.13: Sorption pump installed on the radial port of the SST-1 Tokamak.

Indigenous cryopump for space: AGASTYA-400:

The acronym AGASTYA stands for A GAS Trapping YAntra. AGASTYA-400 (Fig. A.4.14) is a 400 mm opening liquid nitrogen cooled sorption cryopump. Gas molecules are trapped on cryopanel surfaces following cryo-condensation, cryosorption and cryo-trapping processes. At 77 K, the cryosorption cryopump is capable of pumping nitrogen, water vapour and most of the hydrocarbons with activated charcoal coated on the cryopanel surfaces acting as a sorbent. AGASTYA-400 is modular in concept. Three such systems are in operation at Space Applications Centre (SAC-ISRO), Ahmedabad to evacuate cryovac chambers providing ~4000 l/s pumping speed for nitrogen/air and >15000 l/s pumping speed for water vapour. The technology of the cryopump has also been transferred to two Indian industries for commercialization.

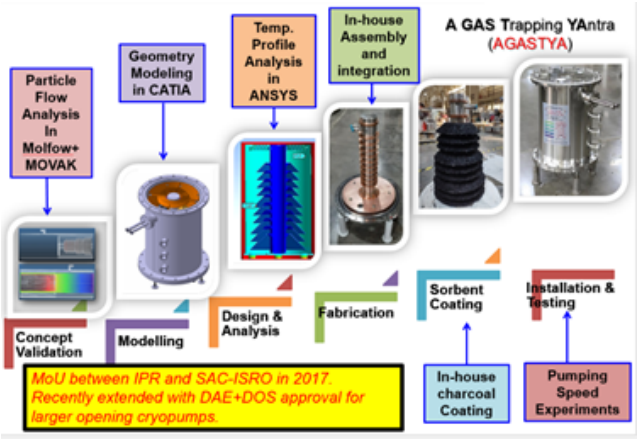

Figure A.4.14: Indigenously developed cryopump for space: AGASTYA-400.

Indigenously developed high pressure helium circulator: A high pressure helium circulator (Fig. A.4.15) has been indigenously developed by modifying a locally-available air turbo-blower. It has been successfully tested with operating pressure ranging from 1 to 30 bar with a leak rate of less than 5 x 10^{-5} mbar.l/s. It can provide a pressure head of ~120 mbar. The maximum flow rate of helium (at the maximum operating pressure) is 28 g/s. The cost of such circulators is substantially lower as compared to imported circulators, and hence can be a potential import substitute.

Figure A.4.15: Indigenously developed high pressure helium circulator.

A.4.5 Remote Handling and Robotic Technologies

Remote handling development: imaging system for external user agency: Institute had earlier developed and supplied a fiber optic based imaging system (Fig. A.4.16) to an external user agency for imaging of radioactive waste in a hot cell. As the next step and based on functional requirements proposed by the user, a new prototype remote handling manipulation system for manoeuvring of the optical fibre lens bundle inside the hot cell has been developed.

The system has an overall diameter of ~175 mm and has a motion range of +/- 70 degree in horizontal & +/- 70 degrees in vertical direction. The system is radiation-compatible as it has been designed with a tendon driven mechanism having all motors/

drives placed outside the working environment.

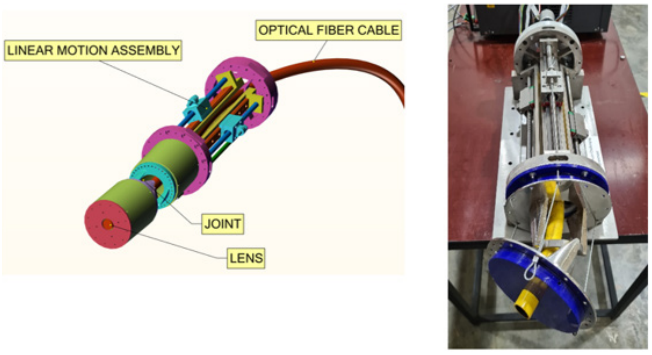

Figure A.4.16: Prototype manipulator for maneuvering the lens bundle.

A.4.6 Negative Ion Neutral Beam (NNBI) Technologies

The NNBI program is an R&D program dedicated to beam and technology development in parallel. Two test beds, the ROBIN and the TWIN are in use to develop H^- beams with target parameters set to ITER DNB needs to be demonstrated in the IN-TF. The technology development program concentrates on developing materials and fusion technologies relevant to neutral beam lines. This has an objective of capability enhancement and to reduce import dependence.

Experiments for Negative Ion Sources: This year's experiments were aimed towards further improving the ROBIN source operations at low filling pressures of ~ 0.3 Pa in terms of reducing co-extracted electrons and improving the e^-/ion ratios ≤ 1 for H^- current densities > 30 mA/cm^2. A configurational modification in terms of additional electrodes has been implemented diagonally at the top and bottom position in the extraction region in ROBIN (Fig. A.4.17a). The experimental configuration was set in a way so as to allow for independent and simultaneous biasing of the rods to study the effects on the source performance in detail. The estimated Cs consumption in this campaign is ~10 mg/hr. The beam transmission was found in the range of 60-80%. Figure A.4.17b shows the ROBIN performance plot of achieved H^- ion densities as a function of the electron to ion ratios for different source filling pressures.

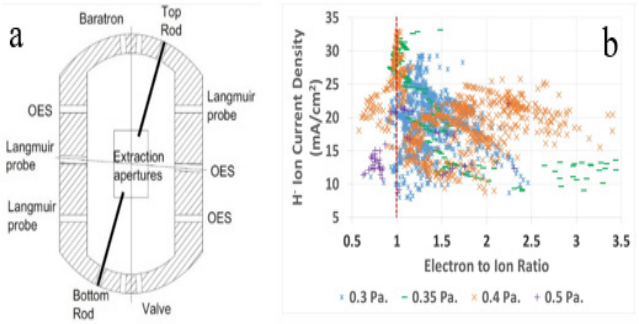

Figure A.4.17:a) Implementation of diagonal electrodes in extraction region and various other diagnostics in ROBIN and b) Source performance in terms of ion beam current density and electron-to-ion ratio.

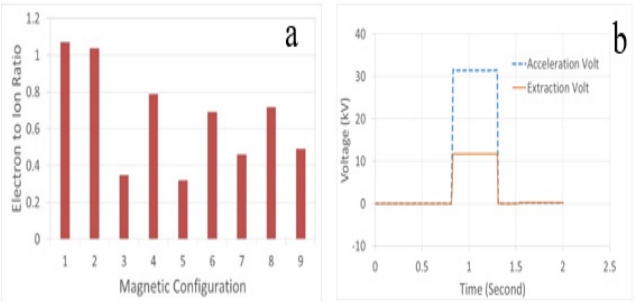

Figure A.4.18: a) Ion source performance as a function of plasma confinement magnet configurations b) Simultaneous application of full capacity extraction (11 kV) and acceleration (35 kV) voltages without breakdowns during beam extraction.

Additionally, set of dedicated experiments were

performed on the ROBIN test bed to see the influence of plasma confinement magnet configurations on the electron-to-ion ratio. The observations revealed that the source performance remained the same for walls lined all along with magnets, without magnets and only with a single column of magnets in proximity of the source filter magnets. However for the case where the polarity of the magnets of the single column magnets matched the polarity of the filter magnets the electron to ion ratios went down to as low as 0.3 for a source operation at 0.3 Pa filling pressure (configuration 3, Fig. A.4.18a) and achieved for the first time since ROBIN operational initiation. Further, a magnet arrangement with different field strengths at the top and bottom half of the source produces an operational scenario where the plasma uniformity in the source is seen to improve substantially at the cost of a minor increase in the e^-/ion ratio (configuration 9, Fig. A.4.18b). This is a significant finding as it indicates that local tuning of the filter fields could be on option towards obtaining a 10% asymmetry tolerance for ensuring uniform beams from such sources. The maximum energy of negative ion beam during this campaign is 46 kV which corresponds to 11 kV extraction and 35 kV acceleration. This establishes a successful utilization of the full capacity of the high voltage power supplies i.e. 11 kV extraction and 35 kV acceleration voltage (Fig. A.4.18b.

Technology development: The beam extraction/acceleration grid segments for the TWIN source have been successfully manufactured (Fig. A.4.19). This milestone has been a major accomplishment of this year, as these grids are first of its kind manufactured indigenously on full scale by vacuum brazing method to close the grid water cooling channels which forms an alternative to the conventional way by electro-deposition.

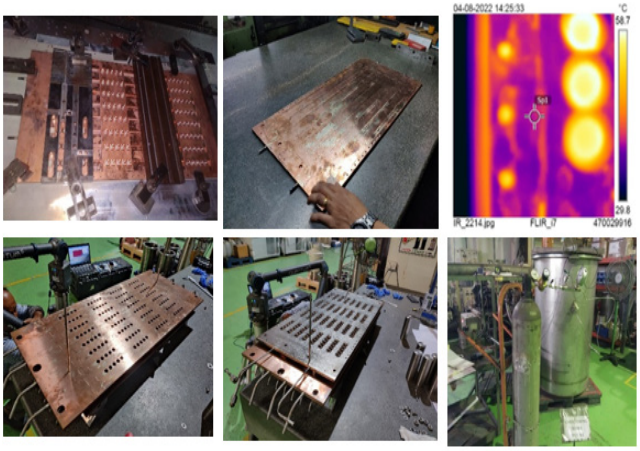

Figure A.4.19: Development of the grid system for the TWIN source using brazing.

Post Insulators ceramic cylinders fitted with stainless steel flanges and high voltage shields specially designed to minimize the electrostatic field stresses have been developed in the Indian industry for the first instance (Fig. A.4.20). Ceramic cylinders are made of high purity (>99%) alumina, unglazed having 0% open porosity. Cold Iso-static process, followed by green machining and furnace sintering leads to the development of the ceramic cylinder.

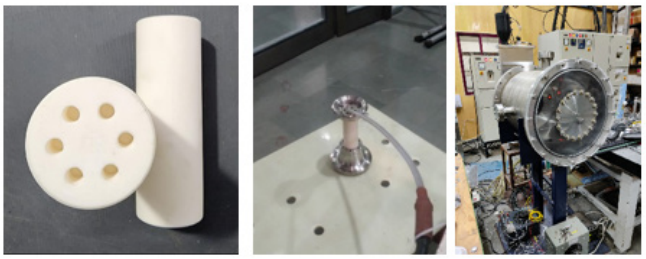

Figure A.4.20: Development of post insulators with insulator metallic flange bolted concept and HV testing.

Final machining and grinding have helped to achieve the desired tolerance of 50 microns in length and flatness of the flange mating surfaces.

The surface roughness is better than Ra 0.8. The Post Insulators have been successfully tested for voltage withstanding in air (atmospheric pressure) and vacuum (< $5x10^{-5}$ mbar) up to 90kV after some initial voltage breakdown conditioning.

Laser Additive Manufacturing (LAM) using a fibre laser, has been applied for cladding of Molybdenum on CuCrZr alloy, for thicknesses up to 1 mm. The focus of this development on a 300 mm x 300 mm substrate has been to understand the effect of process parameters, cladding quality, microstructure and mechanical characteristics and to establish the scalability. After several steps of optimization, a 1mm thick layer of Mo has been successfully deposited with a Ni interlayer (Fig. A.4.21). The work has been carried out in collaboration with LAM division RRCAT, Indore. The samples have been tested and characterized for their surface topography, interface bonding, microstructural characteristics, elemental composition along the depth and mechanical properties.

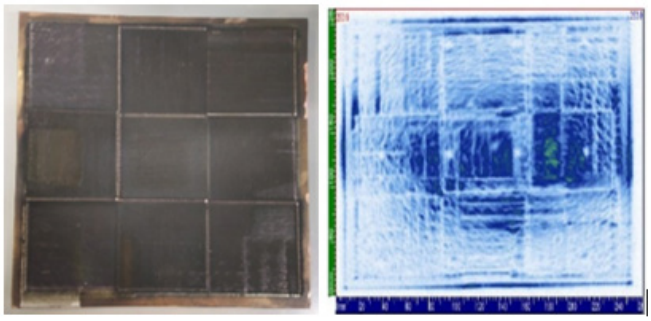

Figure A.4.21: 1 mm Mo deposition on 300 mm x 300 mm CuCrZr with Ni interface using LAM.

Indigenous technology developed for copper electro-deposition in collaboration with RRCAT, has been established for its repeatability over the area of ~300 mm x 300 mm. As the process is highly dependent on the process parameters, the repeatability ensures the reliability of application of the developed process parameters. In addition the progress includes tests of indigenously designed and developed 200 kW 1 MHz direction coupler on a 100 kW water cooled dummy load with 40 kW 1 MHz solid state RF generator and development of GUI based interlocks for the cooling water system of the TWIN source test bed and data acquisition and control system for Temperature and Pressure sensors on the cryopumps installed on INTF.

A.4.7 Neutronics Studies

An indigenously developed accelerator-based 14-MeV neutron generator has been commissioned (Fig. A.4.22 and Fig. A.4.23). The deuterium beam has been characterized by measuring the beam current, beam profile, deuterium fraction, and emittance.

Figure A.4.22: Inaguaration of neutron and ion irradiation facility (NIIF).

The beamline was evacuated to a base pressure of 10^{-7} mbar. The deuterium plasma is produced in the plasma chamber, and the ion beam extracted

through an extraction system. The beam extraction studies have been performed as a function of extraction voltage, microwave power, and mass flow rate. The ion source extracted a 14 mA ion beam with all species, and the analyzing magnet obtained an 11 mA D^+ beam. The measured beam parameters, such as beam width in X and Y and beam emittance, were approximately 9 mm, 12 mm, and 0.27 π mm mrad, respectively. The neutron diagnostics have been characterized by measuring the neutron yield using various techniques, such as AAD, foil activation, and He^{-3} proportional counter. The neutron generator is tested using a stationary and a rotating target. The stationary tritium target produced an average neutron yield of 1.7 x 10^{11} n/s for a beam current and energy of 3 mA and 200 keV, respectively. On the other hand the rotating target produces an average neutron yield of 8 x 10^{11} n/s for a beam current and beam energy of 8 mA and 225 keV, respectively.

Figure A.4.23: NIIF control room.

A.4.8 Power Supply Systems

High Voltage Pulsed DC Power Supply for IGCAR, Kalpakkam: A 25 kW Pulsed HV DC power supply has been successfully integrated with the existing Plasma Nitriding system at Indira Gandhi Centre of Atomic Research (IGCAR), Kalpakkam, Tamilnadu. The integrated plasma nitriding system as shown in figure A.4.24 will be used to nitride the nuclear reactor components. Few test runs of plasma nitriding process have been carried out and found to be satisfactory. The broad specifications of the power supply are listed in Table A.4.1.

Table A.4.1: Specifications of HV Pulsed DC power supply.

Parameter	Requirement
Voltage	0 to -800 V variable
Power	25.6 KW max. (load dependent)
Frequency	20 kHz fixed
Duty cycle	10% to 80% variable
Temperature measurement on HV floating components	0 to 700 °C
Protections	Over current, over voltage and short circuit protections

Figure A.4.24: Pulsed HV DC power supply integrated with plasma nitriding system at IGCAR, Kalpakkam.

Regulated high voltage Power supply for LEHIPA system at BARC: Institute had earlier indigenously developed a 100 kV, 25A Regulated High Voltage Power Supply (RHVPS) for fusion applications.

The in-house technology has also been transferred to ECIL for licensed production of RHVPS. Special features of RHVPS include (a) fast dynamics, (b) regulated voltage at 100 kV level and (c) very low short circuit energy imparted to load. A power supply of this class was first delivered to BARC in 2015 for use in driving the LEHIPA (Low Energy High Intensity Proton Accelerator) experiment. LEHIPA is a complex Linac that is planned to accelerate proton beams to 20 MeV energy and with high intensity, i.e. 30 mA. Very recently, BARC reported that the Drift-Tube Linac of LEHIPA achieved acceleration level of > 6.8MeV. The remaining 2 stages of institute's RHVPS are presently being supplied and commissioned by ECIL team. This achievement has opened a new horizon in independent sourcing of such power systems for the nation.

Integrated testing of Gyrotron at ITER-India Gyrotron Test Facility (IIGTF): ITER India, as a part of its in-kind contribution to the ITER project, has to deliver two high power (1MW/1000 sec) 170 GHz Gyrotron RF source sets. An ITER-India Gyrotron Test Facility (IIGTF) has been established to enable integrated testing and performance demonstration of high power Gyrotrons procured for the purpose. This facility hosts indigenously developed high voltage power supplies (55kV, 110A), channel control system and cooling systems (flow and pressure), which are interfaced with the Gyrotron assembly during the tests (Fig. A.4.25). During a recent acceptance test campaign, a maximum of 650 kW for 1000s and 860 kW for 260s at 170 GHz has been delivered into a dummy load for the first time in India. The achieved performance is at par with similar Gyrotron performance demonstrations in Japan and Europe. In addition to this very important demonstration, IIGTF now stands commissioned for testing of high power long pulse ECRH sources in future.

Figure A.4.25: Testing of Gyrotron at institute's ITER-India lab.

A.5 Theoretical, Modelling & Computational Plasma Physics

Institute has continued its progress in theoretical, modelling and computational research with advanced results published in reputed high impact journals. The significant reported works are summarized below

A.5.1 High Performance Computing

In 2022-23, ANTYA HPC achieved an impressive uptime of 99.7%, showcasing its unwavering commitment to provide uninterrupted computational power. With only one day of downtime for hardware maintenance, researchers were able to leverage ANTYA's exceptional capabilities throughout the year. In the past year, ANTYA maintained its position among the top supercomputers in India in the Top Supercomputers-India list (TopSC.in) released in Jan 2023 by C-DAC, a pan-Indian equivalent of the Top500 HPC list (*https://topsc.cdacb.in/filterdetailstry?page=20&slug=January2023*). Table A.5.1 gives a summary of the computational resources (CPU and GPU) of ANTYA available during the period April 2022 to March 2023.

Expanding Horizons with Advanced GPU Cluster: Recognizing the growing demands of our vibrant research community, Institute has embarked on the journey of procuring a cutting-edge GPU cluster which is expected to be commissioned in the quarter-2 (Q2) or quarter-3 (Q3) of 2023. This dedicated cluster, equipped with 16 A100 GPU cards, will serve as a dynamic test bed for programming models and propel innovation in in-house codes as well as open-source scientific and engineering applications. This step forward empowers researchers to explore the vast potential numerous exciting domains.

Table A.5.1: Computational Resources (April 2022 to March 2023) Summary of 1 PetaFlop ANTYA HPC Facility at the institute.

Resource Name	No. of Nodes	No. of CPU Cores	No. of GPU Cards	RAM (in GB)		Remarks
				/CPU Node	/GPU Card	
CPU Nodes	236	9440	0	376	-	40 cores/node
GPU Nodes	22	880	44	376	16	2xP100 GPU cards/node
High Memory Nodes	02	160	0	1007	-	80 cores/node
Visualization Node	01	40	02	376	24	2xP40 GPU cards/node
Total	**261**	**10520**	**46**	**99398**	**752**	-

In response to the increasing energy consumption of CPU-based facilities, we have gathered user requirements for the next five years and are actively discussing new system implementations. With a forward-thinking approach, institute aims to lever-

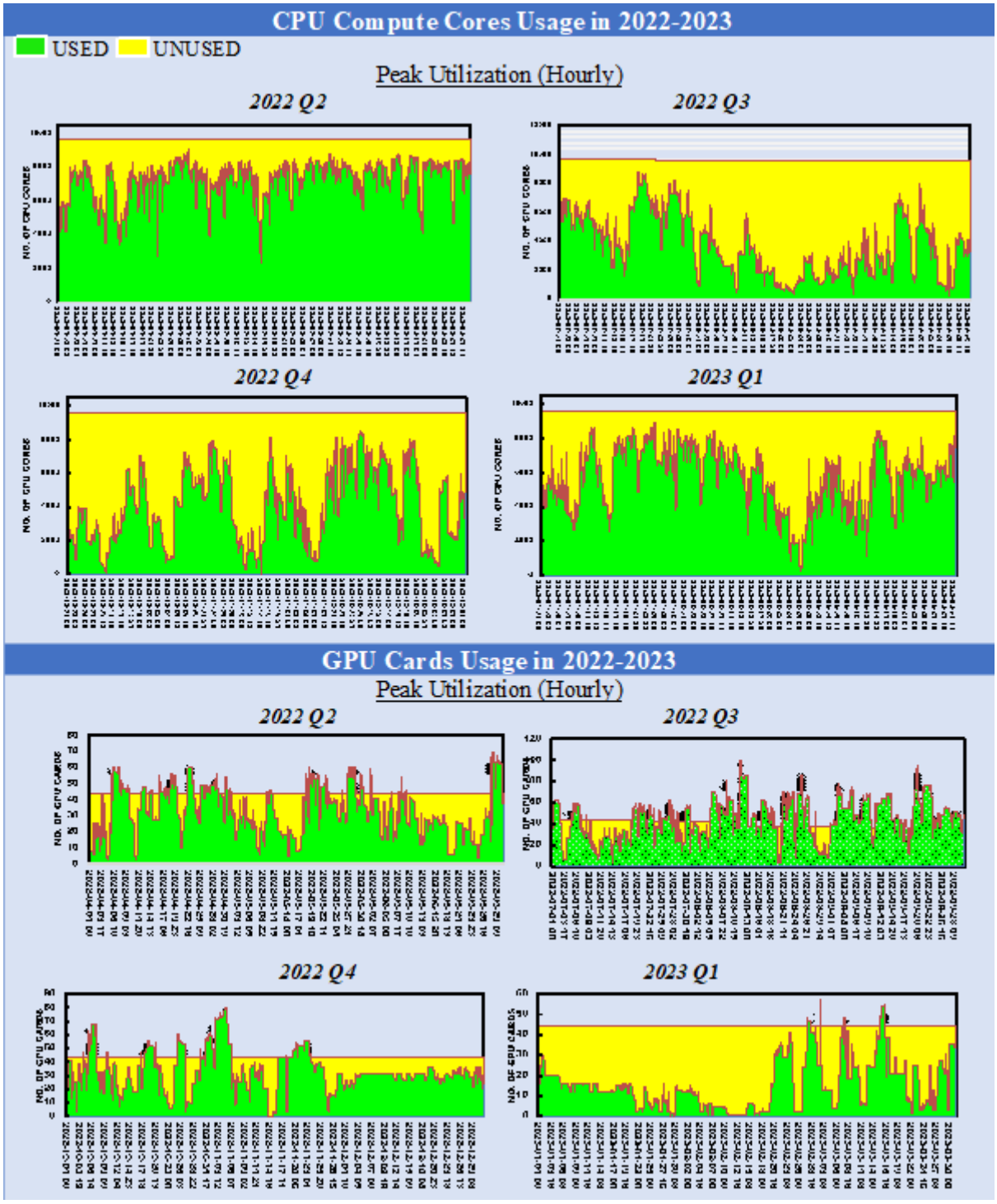

Figure A.5.1: Quarterly utilization charts showing the peak utilization of CPU and GPU compute resources of ANTYA cluster.

age more GPUs to achieve higher computational power with reduced energy consumption. Users are being encouraged to harness the immense potential of GPUs, with over 50% of in-house developed codes already ported for GPU utilization.

I. ANTYA Usage Demographics: In 2022-23, ANTYA welcomed 30 new HPC users, fostering a diverse and collaborative research community. A staggering 49,000 HPC jobs were successfully completed, averaging around 135 jobs per day. These numbers reflect the vital role ANTYA plays in driving innovation and problem-solving across a wide spectrum of scientific disciplines. The quarterly peak utilization charts in Figure A.5.1 illustrates the dynamic and enthusiastic usage of ANTYA's CPU and GPU compute resources.

II. HPC Community Outreach: At the institute, knowledge-sharing and collaboration are at the heart of our endeavours. Our HPC Newsletter, "GAṆANAM" has witnessed flourishing user participation, with insightful research articles contributed by the community. With 12 uninterrupted monthly issues published between April 2022 and March 2023, ANTYA's impact is unmistakable. Completing this year, we celebrated three years of successful operations of ANTYA. Explore all 12 monthly issues available at https://www.ipr.res.in/ANTYA/.

User Trainings and Workshops: GPU Application Hackathon 2022 (GAH-2022): A team comprising three HPC users from the institute participated in the NSM GPU Hackathon 2022 at IIT Bombay. Their objective was to test our in-house developed PIC code on the latest GPU technology available at the renowned National PARAM Supercomputing Facility. Such initiatives enable our users to stay at the forefront of computational advancements.

III. Scientific Highlights: ANTYA has enabled an array of scientific breakthroughs, with over 150 internal publications emanating from the dedicated efforts of HPC users. These publications represent the depth and breadth of research conducted by the institute's HPC users, covering a wide range of scientific domains. From unlocking the secrets of the universe to revolutionizing medical research, ANTYA has been instrumental in empowering researchers to turn their ambitious visions into tangible realities.

Some of the results of recent simulations performed on ANTYA

Simulation Study of Electromagnetic Launcher (EML) System Employing Double Sided Linear Induction Motor (DLIM): The thrust characteristics obtained from the 3D finite element analyses of EML system on ANTYA will aid in designing the experiment facility at the institute (Fig. A.5.2).

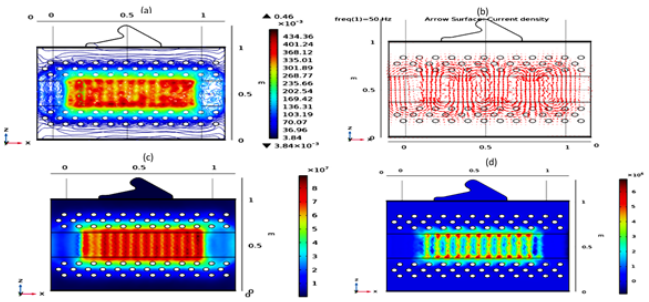

Figure A.5.2: (a) Magnetic flux density magnitude, (b) induced current loops (c) induced current density magnitude and (d) longitudinal force density profile on the carriage plate.

Wettability Gradient Driven Automatic Movement of Liquid Droplet on a Surface: The obtained results of the simulation study predict the drop dynamics and shape evolution on wettability gradient surfaces (WGS) using the Volume of Fluid method

which can be useful in designing and optimizing WGS for many different applications (Fig. A.5.3).

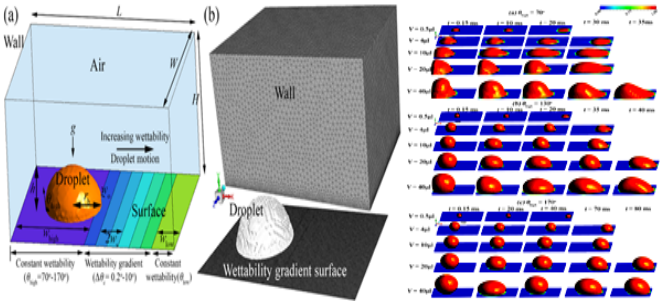

Figure A.5.3: (a) 3-D schematic, (b) Meshed, representation of the computational domain (Right) Spatial-temporal water volume fraction contours of a water droplet in the presence of gravity on wettability graded surface (Δθe) = 100.

Quantitative Accuracy in Predicting the Long Time Fate of a Two-Dimensional Decaying Navier-Stokes (DNS) Turbulence: The obtained results throws light on one of the long standing problems in two-dimensional high-Reynolds number NS turbulence. High resolution DNS using GHD2D code confirms the suitability of KMRS patch vortex theory to quantitative understanding of incompressible turbulent 2D flows, than sinh-Poission model which is based on point vortex model (Fig. A.5.4).

Coupling of Laser Energy to Cluster Electrons in Two Stages Without Any External Injection: An external magnetic field applied perpendicular to laser polarization (B_{ext}~13-20 kilo Tesla) can increase energy absorption per electron cluster 15-30 times

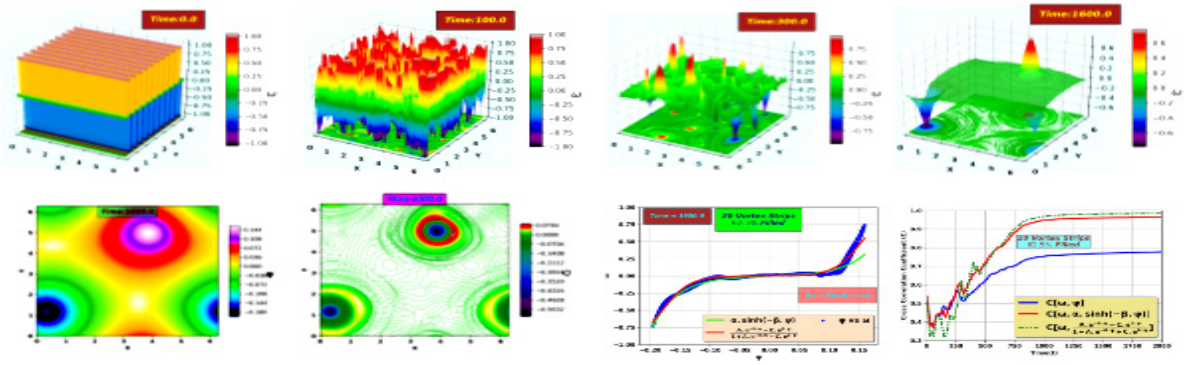

Figure A.5.4: (Top) Time evolution of vorticity (3D visualization) for a tightly packed [62.5%] vortex strips. (Bottom) Late time state of: (a) stream function (Ψ(x,y,t)), (b) Okubo-Weiss parameter (Q(x,y,t)), (c) Ψ-ω scatter plot, (d) Cross-correlation coefficient.

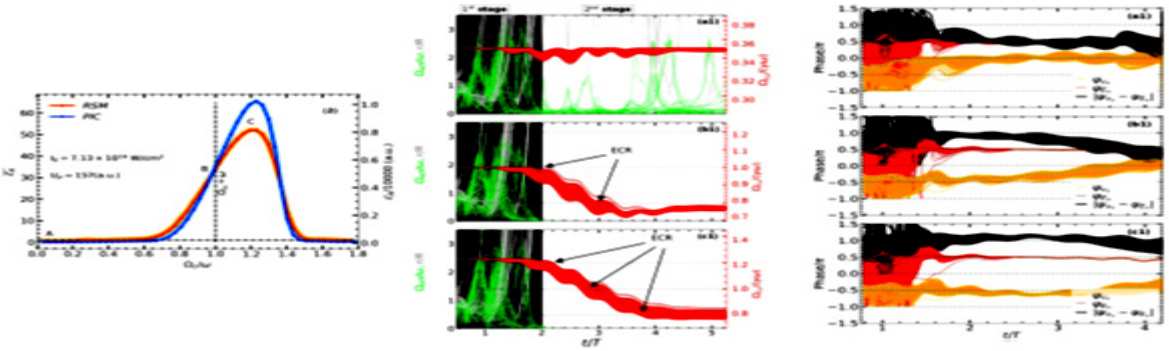

Figure A.5.5: (Left) Comparison of RSM and PIC results: Average absorbed energy normalized with Up(Ɛ𝐴= EA/Up :left axis) and in atomic units (right axis). Absorption at ECR (B) is around 36Up (0.15

MeV) and peaks at 65Up~0.49 MeV (C). (Middle) Time vs. frequency for PIC electrons, normalized Ω_{eff}/ω (green lines, left y-axis) and $\Omega C/\omega$ (red lines, right y-axis) for B_{ext} = 0.02, 0.057, 0.07 (a1, b1, c1) corresponds to point A, B, C respectively. (Right) Phase analysis for PIC electrons, Phase angles ψvx , ψEx and $\Delta\psi$ of all PIC electrons for B_{ext} = 0.02, 0.057, 0.07 (a1, b1, c1) corresponds to point A, B, C respectively. Dashed lines indicates the respective average phase angles $\sum vx/N$ and $\sum Ex/N$ of all N electrons showing average system behaviour.

at ECR $\Omega C = \omega$ (Fig. A.5.5).

Ion-driven Destabilization of a Toroidal Electron Plasma - An Exploration using 3D3VPIC Simulation: This simulation study shows that the toroidal electron plasma dynamics are affected by presence of small number of ions (Fig. A.5.6).

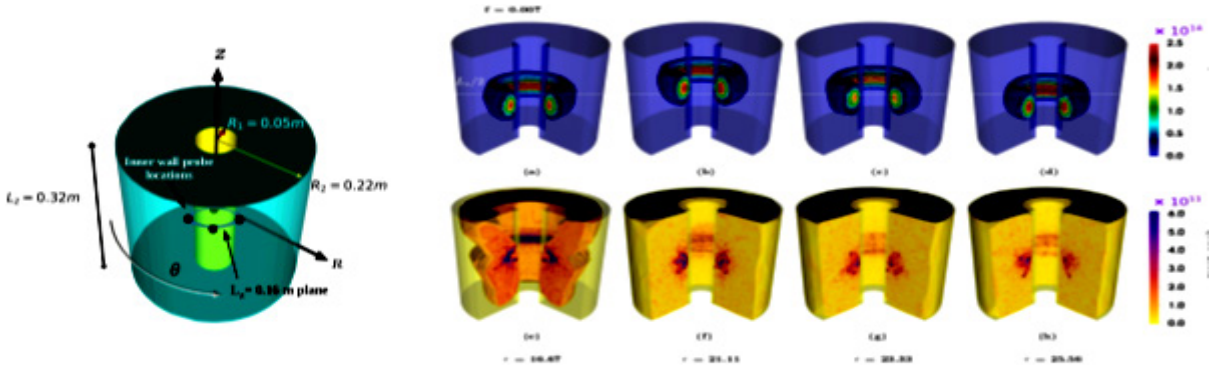

Figure A.5.6: (Left) Schematic diagram of the axisymmetric toroidal vessel with wall probes. (Right) Time evolution of primary electron plasma (a-d) and ion plasma (e-h) with respective density values, for $f = 0.007$ at different simulation time periods τ = 16.67, 21.11, 23.33 and 25.56.

A.5.2 Nonlinear Plasma Theory and Simulation

Microscopic Density Fluctuations for Yukawa Fluids: The thermal motions of particles cause fluctuations in local density of a system, which are responsible for transport processes at microscopic scales. A theoretical study of these microscopic fluctuations in density of a strongly coupled system has been performed. The dynamics are described in the framework of generalized hydrodynamic (GH) model that incorporates strong coupling effects. An analytical form of density autocorrelation function (DAF) is obtained in terms of transport parameters of the system by using an exactly derived Hydrodynamic matrix. The theoretical results are validated using Molecular Dynamics simulations, and the resulting transport parameters are compared.

Effect of radiation reaction on charged particle dynamics in a focused electromagnetic wave: Conventionally, emission of radiation is understood as a loss mechanism, draining the energy of the physical system. In contrast to this intuitive notion, this work shows that for a charged particle interacting with a focused electromagnetic wave, in the regime where radiation reaction dominates over the Lorentz force, radiation reaction forces the particle to cross the focal region resulting in enhanced forward energy gain, figure A.5.7 studies clearly show that the parameter space for forward energy gain reduced by ponderomotive effects, is compensated by radiation reaction effects. This result is of crucial relevance to present day direct laser acceleration schemes of charged particles using intense laser beams.

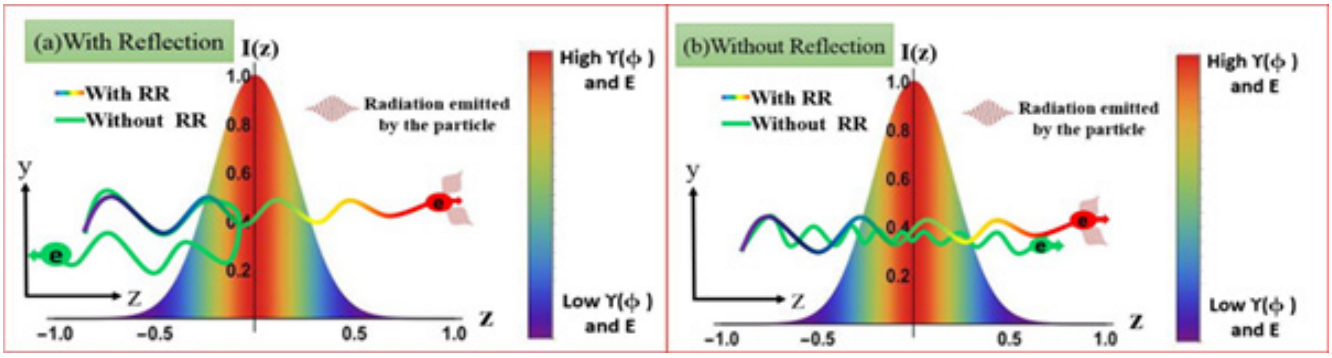

Figure A.5.7: The diagram compares the charged particle dynamics in a focused light wave in the absence/presence of radiation reaction effects. The variation of laser intensity (hence laser electric field) along the direction of propagation (z-axis) due to focusing is shown by a colour bar. (a) and (b) represent particle trajectories with initial conditions which respectively lead to reflection and transmission through the focal point in the absence of radiation reaction forces (the green wavy lines in (a) and (b)). It is shown that inclusion of radiation reaction forces results in transmission through the focal point in both cases, irrespective of the choice of initial conditions, provided radiation reaction force dominates over the Lorentz force. On transmission, the increase in energy of the particle is also shown by change in colour.

Mobility-Induced Phase Separation of Self-Propelled Soft Inertial Disks: The phase diagram of the phenomenon of motility-induced phase separation (MIPS) for a collection of self-propelled interacting disks over a large inertial range is explored using active Langevin dynamics simulation with particular emphasis on disk softness and effective size. It is shown that the parabola-like phase boundary between the homogeneous and MIPS states in the semi-log space of disk softness and

effective size moves towards the hard disk limit with increase in inertia, before completely disappearing in the limit of large inertia. With increase in effective size of the disks, re-entrant phase separation, that is the system phase-separating from a homogeneous phase and eventually re-entering the homogeneous phase, is studied. The structural and the dynamical properties of the different phases are investigated in the considered inertial range. The particular shape of the phase boundary and the re-entrant behavior is explained based on several qualitative and quantitative results. Unlike most of the earlier studies on MIPS, which consider hard particle limits, the present findings may be directly applicable to soft active matter for a range of physical and biological systems.

Re-entrant Phase Separation of a Sparse Collection of Nonreciprocally Aligning Self-Propelled Disks: A model of aligning self-propelled disks that nonreciprocally reorient the self-propulsion directions along the inter particle separation and towards the other disks has been studied. In the limit of small inertia and large softness, where conventional motility-induced phase separation is absent, it is observed that the homogeneous system at a small area fraction phase-separates into clusters and a low-density phase that, eventually, re-enters the homogeneous phase with a monotonic increase in alignment strength. The disks inside the clusters move with a finite space-dependent speed, constantly shuttling between clusters through the surrounding low-density homogeneous phase while maintaining the hexatic structure properties within the clusters. The area fraction gradually increases from the periphery towards the center of the clusters with a negligible correlation of the velocity and propulsion direction inside the clusters. The novel collective behaviour of re-entrant phase separation is found to follow from both the limits of hard disks and extremely small inertia, tending towards the over damped limit. However, important differences in the structural and dynamical properties are shown in the limit of hard disks and extremely small inertia, as compared to that for soft disks at finite inertia. The study shows that the cluster phase is associated with an effective temperature for a wide range of values of alignment strength, whereas an effective temperature is associated with the specific range of alignment in the low-density phase. It is believed that the re-entrant phase behaviour in the limit of small area fraction and the remarkable properties of the clusters should be useful in understanding a wide range of physics issues, ranging from clogging and unclogging to information exchange and transport, in biological and synthetic self-propelled systems.

Parametric Decay Induced First-Order Phase Transition in Two-Dimensional Yukawa Crystals: The melting process of two-dimensional (2D) Yukawa crystals for dusty plasma medium induced by external perturbations has been explored using molecular dynamics simulations. A 2D monolayer of particles interacting via Yukawa pair potential is formed in the presence of an external confinement potential. The confinement potential is a combined effect of the gravitational force and an externally applied electric force, which mimics the sheath electric field in dusty plasma experiments. The response of the 2D crystalline layer to an external perturbation is investigated. It is shown that transverse surface waves are generated below a particular threshold value of initial perturbation, but the crystalline order remains. However, above a threshold value of initial disturbance, the crystalline order structure of the 2D layer breaks, and it melts. The melting process is shown to be a first-order phase transition. It has been demonstrated that the nonlinear amplitude modulation of initial disturbance through the parametric decay instability is responsible for the melting. The proposed

mechanism of first-order phase transition in the context of 2D dusty plasma crystal is distinctly different from the existing theoretical models and can provide a deeper understanding of the experimental observations in the context of plasma crystal.

Auto-Correlations of Microscopic Density Fluctuations for Yukawa Fluids in the Generalized Hydrodynamics Framework with Viscoelastic Effects: This work develops a theoretical procedure for obtaining transport coefficients of Yukawa systems from density fluctuations. The dynamics of Yukawa systems are described in the framework of the generalized hydrodynamic (GH) model that incorporates strong coupling and visco-elastic memory effects by using an exponentially decaying memory function in time. A hydrodynamic matrix for such a system is exactly derived and then used to obtain an analytic expression for the density autocorrelation function (DAF)—a marker of the time dynamics of density fluctuations. The present approach is validated against a DAF obtained from numerical data of Molecular Dynamics (MD) simulations of a dusty plasma system that is a practical example of a Yukawa system. The MD results and analytic expressions derived from the model equations are then used to obtain various transport coefficients and the latter are compared with values available in the literature from other models. Strong coupling and visco-elastic effects are seen to influence the transport parameters. The calculations are useful for obtaining reliable estimates of transport coefficients from experimentally determined DAF.

Collective Behaviour of Soft Self-Propelled Disks with Rotational Inertia: The collective properties of a large system of soft self-propelled inertial disks with active Langevin dynamics simulation in two dimensions have been investigated. Rotational inertia of the disks is found to favour motility induced phase separation (MIPS), due to increased effective persistence of the disks. The MIPS phase diagram in the parameter space of rotational inertia and disk softness is reported over a range of values of translation inertia and self-propulsion strength of the disks. Our analytical prediction of the phase boundary between the homogeneous (no-MIPS) and MIPS state in the limit of small and large rotational inertia is found to agree with the numerical data over a large range of translational inertia. Shape of the high density MIPS phase is found to change from circular to rectangular one as the system moves away from the phase boundary. Structural and dynamical properties of the system, measured by several physical quantities, are found to be invariant in the central region of the high density MIPS phase, whereas they are found to vary gradually near the peripheral region of the high density phase. Importantly, the width of the peripheral region near the phase boundary is much larger compared to the narrow peripheral region far away from the phase boundary. Rich dynamics of the disks inside the high density MIPS phase is addressed. Spatial correlation of velocity of the disks is found to increase with rotational inertia and disk hardness. However, temporal correlation of the disk velocity is found to be a function of rotational inertia, while it is independent of disk softness.

Electromagnetic Pinned Solitons for Space Debris Detection: Electromagnetic "pinned" solitons in the form of stationary nonlinear waves are studied within the framework of an inertial magneto-hydrodynamic model. These structures, that can arise when a charged source moves in a magnetized plasma, have a velocity that is equal to the source velocity and, hence, appear as "pinned" structures that envelope the source. the excitation of such solitons in the Low Earth Orbit region due to the passage of charged orbital debris objects has been investigate. The spatial size of these electromagnetic solitons, typically of the order of a few ion

skin depths, can be very large in this region. Such solitons can be detected using a variety of ground- or orbit-based radio sounding techniques and may provide a convenient additional means of tracking small sized orbital debris objects that are difficult to spot optically.

Bifurcation Behaviour of Resonant Magnetic Perturbation Control of Edge Localized Modes in Tokamaks: Nonlinear Simulation Results: The study relates to obtaining some novel results of two fluid nonlinear simulations on the control of edge localized modes (ELMs) in tokamaks by resonant magnetic perturbations (RMPs). Many experiments around the world have demonstrated that RMPs are effective in possibly mitigating or even completely suppressing strong (type I) ELMs that would seriously degrade confinement and could cause other heat-flux problems in both present (e.g. JET) and planned future tokamaks (ITER). The present simulations demonstrate that non-axisymmetric RMPs with toroidal mode numbers n=2,3,4 and suitable field-strengths (kA-turns) at the plasma wall imply significant bifurcations in their ability to mitigate or even suppress type-I ELMs, qualitatively similar to RMP effects on ELMs reported in experiments.

Signatures of an Energetic Charged Body Streaming in a Plasma: A charged body moving in a plasma can excite a variety of linear and nonlinear waves in the form of trailing wakes, fore-wake shocks, and precursor solitons. These structures can further interact with the background plasma to create secondary effects that can serve as signatures of the passage of the charged body. Using particle-in-cell simulations, a basic investigation of the dynamics of a plasma system that is being traversed by an energetic charged body has been carried out. Using two different shapes of this charged source, namely, an idealized infinite length planar source and a two-dimensional thin rectangular source, the differences in the nature of the excited wave structures and their consequent impact on the background plasma have been examined. The simulations reveal interesting features such as the dependence of the precursor speeds on the total charge on the driving source, local particle trapping, and energization of the trapped particles in various regions along the traversal path leading to the formation of energetic charged beamlets. Such basic findings could find practical applications in analyzing the trajectories of charged objects like space debris orbiting in the ionosphere.

Quasi-Localized Charge Approximation Approach for the Nonlinear Structures in Strongly Coupled Yukawa Systems: Strongly coupled systems occupying the transitional range between the Wigner crystal and fluid phases are the most dynamic constituents of the nature. Highly localized but strongly interacting elements in this phase possess enough thermal energy to trigger the transition between a variety of short to long range order phases. Nonlinear excitations are often carriers of proliferating structural modifications in the strongly coupled Yukawa systems. Well represented by laboratory dusty plasmas, these systems show explicit propagation of nonlinear shocks and solitary structures both in experiments and first principles simulations. The shorter scale length contributions remain absent at strong screening in the present approximate models, which nevertheless prescribe nonlinear solitary solutions that consequently lose their coherence in a numerical evolution of the system under the special implementation of a quasi-localized charge approximation (QLCA) formulation. The stable coherent structures self-consistently emerge following an initial transient in the numerical evolution that adapts QLCA approach to spatiotemporal domain for accessing the nonlinear excitations in the strong screening limit. The present $\kappa \sim 1$ limit of the existing Yukawa fluid

models to show agreement with the experiment and molecular dynamical simulations has been overcome and the coherent nonlinear excitations have become characterizable up to κ~2.7, before they become computationally challenging in the present implementation.

A.5.3 Tokamak and Fusion Reactor Studies

Numerical Study on the Effect of Plasma Density on Runaway Electron Suppression in the ADITYA-U Tokamak: Runaway Electrons (REs) generated during plasma disruptions in fusion grade tokamaks have the potential to severely damage the plasma-facing components. Designing optimal plasma discharge scenarios for RE suppression in future experiments requires interpretative modelling of current experiments. Multiple experiments have been carried out on ADITYA-U tokamak to design optimal plasma discharge scenarios for RE avoidance and suppression. Two representative pairs of ADITYA-U plasma discharges have been numerically studied. In the first pair of discharges, plasma density was increased by gas puffs during the flap-top phase which is shown to suppress RE generation. In the second pair of the representative discharges, the effect of a lower ratio of peak electric field during breakdown to the pre-fill pressure is shown on RE generation. These plasma discharges are simulated using the PREDICT code to study the dynamics of RE's. The results are found to be consistent with the experimental Hard X-Ray diagnostic observations for both the pair of representative discharges. Additionally, the lowest RE-current is obtained in the discharges with a low ratio of the peak electric field during breakdown to the pre-fill pressure and high plasma density during the flap-top phase due to gas puffs. The suppression of REs is demonstrated by showing the effect of increasing plasma density on the separatrix in momentum space between thermal electrons and REs.

Sensing Size Change of a Circular Tokamak Plasma using a Single Magnetic Probe: A Theoretical Approach: A tokamak is a toroidal device in which the donut shaped plasma is confined by means of external magnetic field. The externally measured magnetic field due to the plasma column carries several information about the plasma and these include total plasma current, the position of plasma column centroid, the shape of plasma etc. To diagnose these mentioned parameters, several magnetic diagnostics are used and this requires adequate data processing, which is not always very straight forward. In contrary, present theoretical study focus on a rather simple approach of estimating magnetic field at a given location with respect to circular plasma to figure out the change in size of the plasma column. Moreover, this study reveals that the required estimation is very much sensitive to the choice of location for measurement of magnetic field and completely depends on the geometry of the tokamak which makes it tokamak machine-specific. A subtle approach has been explored to generalise such observations and establish the usefulness of this approach for any tokamak-like machine.

Edge Biasing and its Impact on the Edge and SOL Turbulence: A theoretical study is made to study the effect of edge biasing on the dynamics of the interchange turbulence in the edge and scrape-off layer regions. A linear analysis of a set of model fluid equations shows that biasing stabilizes the small ky modes. The model equations are next solved numerically, using the BOUT++ framework, to explore the nonlinear dynamics in the presence of positive or negative bias and compared to results in the absence of bias. Positive biasing is found to lead to a larger increment in plasma density and temperature as compared to negative biasing. It is further observed that cross-correlation between density and poloidal electric field at dif-

ferent radial positions decreases for positive biasing and in the case of negative biasing it is almost similar to that of no biasing. Plasma density and poloidal electric field fluctuations have been investigated which show that the density fluctuations increase (decrease) for positive (negative) biasing but the radially outward flux for these biasing cases always decreases mainly due to the decrease of cross-correlation between density and poloidal electric field fluctuations.

Blob Tracking and Formation in Edge and SOL Plasmas using Q-Factor: The study involves proposing a direct means of identifying and tracking plasma blobs in the tokamak edge and scrape-off layer (SOL) regions through evaluation of a quantity Q which is a measure of the relative contribution from the square of the sheared strain and the square of the vorticity at any spatial location. The sheared strain and vorticity are related to the various velocity gradients in the plasma fluid. The blob formation from the breakup of a streamer structure can be determined from the criterion $Q > 0$. A blob is associated with a high negative value of Q that is indicative of a stable vortex flow of the local fluid trajectories. The validity of this criterion, obtained from a linear eigenvalue analysis of the stability of fluid trajectories, is supported by nonlinear fluid simulations that clearly identify blobs with regions where $Q < 0$ and exceeds a threshold value. The parameter Q can be experimentally determined from measurements of local electric field shears using gas puff imaging or Langmuir probe techniques, and the proposed criterion can provide a direct means of tracking plasma blobs. The rotation or spin of a blob in the edge and SOL regions can also be characterized by Q.

Scaling of Reconnection Parameters in Magnetic Island Coalescence: Role of In-Plane Shear Flow: A 2D incompressible visco-resistive-MHD model is used to study the scaling of reconnection parameters in the magnetic island coalescence problem under two interesting scenarios. First, the effect of changing island half-width at a fixed system size is investigated. As the island half-width increases, the total magnetic flux content of the islands increases, resulting in an increase in upstream magnetic field, upstream velocity field, and un-normalized reconnection rate. However, the downstream magnetic field, current sheet length and normalized reconnection rate (normalized to the upstream magnetic field and upstream Alfvénic velocity) remain independent of it. Interestingly, the reconnection rate is found to be different from the upstream to downstream velocity ratio as well as from the aspect ratio of the current sheet, as opposed to the findings of the Sweet–Parker model. Second, the in-plane shear flow effects are studied, keeping the island width and system size fixed. Here, thickness and length of the current sheet, the upstream magnetic and velocity field components, reconnection rate and time, current sheet inclination angle with shear flow length scale, and amplitude are calculated. Interestingly, the inclination angle of the current sheet and the diffusion region are found to be different, and the differences are more in stronger shear flows. These results are significantly different from the Harris sheet setup with shear flow.

Global Gyrokinetic Simulations of Electrostatic Microturbulent Transport using Kinetic Electrons in LHD Stellarator: Global gyrokinetic simulations of ion temperature gradient (ITG) and trapped electron mode (TEM) in the LHD stellarator are carried out using the gyrokinetic toroidal code (GTC) with kinetic electrons. ITG simulations show that kinetic electron effects increase the growth rate by more than 50% and more than double the turbulent transport levels compared with simulations using adiabatic electrons. Zonal flow dominates the saturation mechanism in the ITG turbulence. Nonlinear

simulations of the TEM turbulence show that the main saturation mechanism is not the zonal flow but the inverse cascade of high to low toroidal harmonics. Further nonlinear simulations with various pressure profiles indicate that the ITG turbulence is more effective in driving heat conductivity whereas the TEM turbulence is more effective for particle diffusivity.

Low-Pressure Adsorption of Hydrogen Isotopologues on LTA4A Zeolites - A Grand Canonical Monte Carlo Simulation Study: Effective removal of the trace quantities of hydrogen and its isotopologues is crucial for the proper functioning of the tritium extraction system (TES) in the fuel cycle system of the fusion reactor. Zeolite molecular sieves of Linde Type A (LTA) framework are considered potential adsorbent materials for the cryogenic molecular sieve bed (CMSB) of the TES. However, the adsorption isotherm data of H_2, HD, D_2, HT, DT, and T_2 on LTA 4A zeolites at low pressures (1–1000 Pa) and 77.4 K temperature is scarce in the literature. Grand canonical Monte Carlo (GCMC) simulations have been performed to study the hydrogen isotopologues adsorption in the pressure and temperature ranges of operation of the CMSB of TES. The adsorption isotherms show that the equilibrium loading capacity is larger for T_2, followed by D_2 and H_2 at 77.4 K. In the case of heteronuclear isotopologues, the loading capacity is larger for DT, followed by HT and HD under the same conditions of interest. The increase in the equilibrium adsorption capacity with isotopic mass could be attributed to the difference in the zero-point energies of the isotopologues. The effect of Si/Al ratio in the LTA zeolites on the cryosorption of hydrogen isotopes is investigated. The results show that, as the Si/Al ratio decreased, the equilibrium loading of the hydrogen molecules increased.

Estimation of Production Cross-Sections, Transmutation and Gas Generation from Radionuclides (A ~50-60) in Fusion Environment: Degradation of material properties under neutron irradiation generates a requirement for studying effects on materials in a fusion environment and optimizing radiation-resistant materials for future applications. In this work, the durability of stainless steel (SS) alloy used in ITER-like fusion devices is studied. The amount of radionuclides produced in the material upon neutron irradiation at various locations is determined using the ACTYS, neutron activation code, for a typical one-dimensional geometry of ITER-like fusion reactor. The ACTYS code is further used to determine the gas production from ^{55}Fe, ^{59}Ni, and other long-lived radionuclides in the material. To further stress the importance of gas production in fusion materials, a comparative study of gas production cross-sections as given in various standard data libraries has been studied using TALYS-1.8.

On Suitable Experiments for Demonstrating the Feasibility of the Beam-Driven Plasma Neutraliser for Neutral Beam Injectors for Fusion Reactors: Plasma neutralisers promise increased neutralisation efficiency of negative ion beams in neutral beam injection (NBI) beam lines compared with gas neutralisers. It has been suggested that, in the presence of an electron-confining magnetic cusp field along all neutraliser walls, the beam itself could ionise the neutraliser gas sufficiently to take advantage of this effect, avoiding the added complexity of external power coupling to the neutraliser. These predictions come from a zero-dimensional model by Surrey and Holmes and Turner and Holmes. In this study, the same have been revisited and the model is modified by introducing slowing-down energy distributions for stripped and Rudd electrons, including electron impact dissociation as an electron energy loss channel and taking into account dissociative recombination of molecular ions

with electrons. Including the latter effect reduces the predicted plasma density by about a factor of four and the achievable neutralisation yield from 80% to 68% in the case of a negative deuterium ion beam with an energy of 1 MeV and a current of 40 A. With this revised model the expected performance of potential beam-driven plasma neutralisers (BDPN) on a variety of existing negative ion beam test facilities for NBI is estimated. Based on these results, it is concluded that the most suitable proof-of-principle experiment would be a dedicated chamber, ideally of the same dimensions and with the same magnetic cusp configuration as a BDPN for the DEMO NBI, in which the plasma is not created primarily by the fast electrons stripped from the beam ions, but by electrons of similar current and energy emitted from biased filaments.

Validation of 3-D Non-Isothermal CFD Simulation with Experimental Results for Single-Screw Hydrogen Extruder: The single-screw extruder is used for the continuous formation of solid rod of hydrogen ice and its isotopes. The extruded rod, further, requires to be cut into pellets and injected into the magnetically confined hot plasma for the fuelling of long-pulse fusion reactors. An extruder is capable to produce and continuously supply the pellets at a frequency of 1–40 Hz. The design and development of a solid hydrogen screw-extruder system requires a study of the visco-plastic behaviour of solid hydrogen and its effects on the pressure and speed of the extruder. A CFD tool (Polyflow) from ANSYS is employed to estimate the characteristics of the pressure developed by the extruder at different rotational speed of the screw. In the simulations, different Shear Stress Models developed by various researchers are implemented and the results of the same are investigated systematically for Single-Screw Hydrogen Extruder. The results obtained from these simulations are validated with the experimental results on single screw extruder.

A.5.4 Fundamental Plasma Studies

Numerical Simulation of a Bi-Directional Plasma Thruster for Space Debris Removal: A spacecraft during mission typically switches from chemical propulsion to electric propulsion once it lifts out of the Earth's gravity as the thrust requirement to drive it reduces substantially. Consequently, electric propulsion technology is commonly used for deep space mission, satellite orbit keeping and orbit correction. In the last few decades, the amount of man-made space junk (space debris) has increased enormously and has become a potential danger for space stations, space shuttles and other live satellites. A bi-directional plasma thruster, mounted on a satellite, can be used to remove space debris during satellite operation. A directed ion beam ejected from a plasma thruster imparts a net force on space debris to decelerate and facilitate manoeuvring and re-entry of space debris into the Earth's atmosphere where it can burn out. A detailed 1D3V PIC-MCC (particle in cell-Monte Carlo collision) simulation of a bi- directional plasma thruster has been worked upon in these studies. To this end, a PIC-MCC solver which resolves thruster axial direction and all three velocity dimensions is used to study a magnetic nozzle plasma thruster with both ends open (bi-directional plasma thruster). It is seen that such a bi-directional plasma thruster can be used to accelerate–decelerate a live satellite and also to remove space debris by altering the magnetic field spatial profile in the plasma expansion region.

Emergence of Directed Motion in a 2D System of Yukawa Particles on 1D Ratchet: Directed motion in a 2D system of particles interacting via Yukawa force on a one-dimensional asymmetric periodic Ratchet and subjected to time periodic drive has been studied. The presence of directed motion through a measure of non-zero average velocity despite external forces having zero spatio-temporal

average has been observed. The directed motion is found to be a non-monotonic function of strength and frequency of external time periodic drive for a fixed set of Ratchet parameters. The peak of directed velocity is found to shift to high driving strengths with increase in driving frequency. The dynamics of the system is explored through various diagnostics such as average position, average velocity, diffusion, power cycle, probability distribution. The presence of a peculiar feature called hysteresis in velocity when external drive force varies during its period introduces a phase shift in the system. It is observed that it is the interplay of driving strength and frequencies which decides the dynamics of the system.

Long Time Fate of Two-Dimensional Incompressible High Reynolds Number Navier-Stokes Turbulence: A Quantitative Comparison between Theory and Simulation: Predicting the long time or late time states of two-dimensional incompressible, high Reynolds number, slowly decaying turbulence has been one of the long-standing problems. Using "point vortices" as "inviscid" building blocks, which do not respect incompressibility, statistical mechanical models conserving only total energy and zero total circulation result in the well-known sinh-Poisson relation between vorticity and stream function. On the other hand, statistical mechanics of "inviscid patch" vortices, which respects incompressibility by conserving regions of zero and nonzero vorticity, predicts a generalized relaxed state, which has never been systematically compared with direct numerical simulations (DNS). In this study, starting from highly packed regions of nonzero initial vorticity and using high resolution, high Reynolds number DNS it is seen that the late time states agree with predictions from patch vortex models. As total circulation is reduced or diluted, it is seen that late time states of the DNS systematically and unambiguously leads to the sinh-Poisson relationship between vorticity and stream function. Such quantitative findings possibly solve one of the long-standing problems in two-dimensional turbulence.

Data Driven Discovery of a Model Equation for Anode-Glow Oscillations in a Low Pressure Plasma Discharge: A plasma glow discharge tube, a versatile device widely employed in several scientific and industrial applications, is also a useful tool for many basic plasma studies in the laboratory. Anode glow oscillations are well-known phenomena in such devices that arise from an instability of the plasma glow around a small positively charged electrode. Depending upon the gas pressure, the applied DC voltage, and the distance between the electrodes, these oscillations can display a rich dynamical behaviour. Over a certain parametric regime, these nonlinear oscillations exhibit a stable limit cycle behaviour that has been modelled in the past by a Van der Pol like equation. While such a model equation provides a qualitative description of the observations, it lacks quantitative agreement and does not have any predictive capability. In the present study the sparse identification of nonlinear dynamics (SINDy) method is used to obtain a model equation directly from a time series of the experimental data. This model captures well the main features of the experimental data in a quantitative manner. It also shows a significant deviation from the Van der Pol model due to additional contributions that are akin to nonlinear damping in a Rayleigh oscillator. Such a hybrid Van der Pol–Rayleigh oscillator model could provide a useful paradigm for future explorations of the nonlinear dynamics of this system.

Effect of Directional Nature of Antenna and Magnetic Field Strength on Optimal Power Absorption in a Helicon Discharge: The power absorption in a helicon plasma source excited by 13.56 MHz fre-

quency is studied. Numerical analysis is carried out to determine the power absorption in helicon discharge for m = +1 mode, considering both helicon and electrostatic Trivelpiece–Gould (TG) waves. The effects of electron density, external magnetic field strength, parallel wave number, antenna type and antenna length on the power absorption are investigated. The power absorption is obtained by considering that the radio frequency (RF) wave propagates in uniform plasma in a constant magnetic field. Maxwell's equations are solved in the plasma and vacuum regions using boundary conditions to obtain the amplitude of the helicon and TG waves. It is found that higher power is absorbed in case of half-helical antenna due to its asymmetric nature as compared to Nagoya Type 3 antenna of the same length. Moreover, an optimization of parameters involving antenna dimensions, propagation vector, and external magnetic field strength, was estimated for optimal power absorption in a helicon discharge.

Equilibrium Properties of Inhomogeneous Partially-Magnetized Plasma Containing Negative Ions: An analytical model for inhomogeneous, partially-magnetized electronegative plasma has been studied. It is shown that the radial potential of the plasma can be related to the electronegativity parameter $\alpha = n_v/n_e$, the positive ion density, and the electron temperature distribution inside the plasma system. Using this expression, the electronegativity parameter has been determined in an oxygen plasma produced by a 13.56 MHz capacitive coupled radio-frequency discharge. It is seen that the negative ion parameter obtained using this model is in good qualitative agreement with the saturation current ratio technique based on the cylindrical Langmuir probe.

Investigating the Effects of Electron Bounce-Cyclotron Resonance on Plasma Dynamics in Capacitive Discharges Operated In The Presence Of a Weak Transverse Magnetic Field: The existence of an enhanced operating regime has been observed when a low-pressure (5 mTorr) capacitively coupled discharge (CCP) is driven by a very high radio frequency (60 MHz) source in the presence of a weak external magnetic field applied parallel to its electrodes. The particle-in-cell simulations show that a significantly higher bulk plasma density and ion flux can be achieved at the electrode when the electron cyclotron frequency equals half of the applied radio frequency for a given fixed voltage. A detailed look at this phenomenon and further delineate the effect of this "electron bounce-cyclotron resonance (EBCR)" on the electron and ion dynamics of the system has been studied. It is observed that the ionization collision rate and stochastic heating are maximum under resonance condition. The electron energy distribution function also indicates that the population of tail-end electrons is highest for the case where EBCR is maximum. Formation of electric field transients in the bulk plasma region is also seen at lower values of applied magnetic field. Finally, it is demonstrated that the EBCR-induced effect is a low-pressure phenomenon and weakens as the neutral gas pressure increases. The studies have a potential utility of this effect to advance the operational performance of CCP devices for industrial purposes.

Formation of Nonlinear Stationary Structures in Ionospheric Plasma: Solar radiation, along with cosmic radiation, ionizes the Earth's atmosphere and creates a dense layer known as the ionosphere. By considering weakly relativistic degenerate plasma in the planetary ionosphere, the formation and nature of the solitary structure, electrostatic double layers (DLs) and so on have been studied. As one considers weak relativistic degeneracy, only electrons get accelerated and are the key to stationary structures. Sagdeev's pseudopotential method,

standard Gardner equation, has been implemented to identify regimes where the solitary formation and DLs may be observed. The parametric influences on solitons and DLs have also been studied. Furthermore, these have been extended to include the oscillatory Rossby solitons in the ionospheric plasma. The results so obtained may help to interpret many high-energy atmospheric observations in the ionospheric plasma.

Plasma Asymmetry and Electron and Ion Energy Distribution Function in Capacitive Discharges Excited By Tailored Waveforms: Using a particle-in-cell simulation technique, the plasma and ionization asymmetry, higher harmonics generation, and electron and ion energy distribution function (IEDF) in capacitive discharges excited by tailored waveforms have been studied. At a base frequency of 13.56 MHz, three different waveforms, namely sinusoidal, sawtooth, and square, are applied for a constant current density amplitude of 50 A m^{-2} and gas pressure of 5 mTorr. The simulation results show that the square waveform produces the highest plasma density in the discharge, whereas maximum asymmetry is observed for plasma excited by the sawtooth-like waveform. Both square and sawtooth waveforms generate multiple beams of high-energy electrons from near to the expanding phase of the sheath edge and high-frequency modulations up to 100 MHz on the instantaneous sheath position. The electron energy distribution function depicts three electron temperatures and highly elevated tail-end electrons for the square waveform in comparison to the sinusoidal and sawtooth waveform. The IEDF is bimodal at both the powered and grounded electrodes with a large asymmetry and narrow-type distribution in the case of the sawtooth-like waveform. The results suggest that the choice of waveform is highly critical for achieving maximum asymmetry and plasma density simultaneously in capacitive discharges.

Wave Breaking Limit in Arbitrary Mass Ratio Warm Plasmas: The maximum sustainable amplitude, so-called wave breaking limit, of a nonlinear plasma wave in arbitrary mass ratio warm plasmas is obtained in the non-relativistic regime. Using the method of Sagdeev potential, a general wave breaking formula is derived by taking into account the dynamics of both the species having finite temperature. It is found that the maximum amplitude of the plasma wave decreases monotonically with the increase in temperature β_- of the negative species (temperature β_+ of the positive species) and increases (decreases) with increase with their mass ratio.

Coupling of 'Cold' Electron Plasma Wave via Stationary Ion Inhomogeneity to the Plasma Bulk: Using high resolution kinetic (VPPM-OMP 1.0) and fluid (BOUT++) solvers, evolution of long-wavelength electron plasma wave (EPW) in the presence of stationary periodic ion background non-uniformity is investigated. Mode coupling dynamics between long-wavelength EPW mode of scale k and ion inhomogeneity of scale k_0 is observed. Validity of well-known Bessel function $J_n(x)$ scaling in the cold plasma approximation (i.e., when phase velocity $\omega/k >> v_{thermal}$) alongwith the effect of ion inhomogeneity amplitude (A) on temporal evolution of energy density in the long-wavelength EPW mode is investigated. Effect of finite system sizes on the Bessel $J_n(x)$ scaling is examined and scaling law for τFM i.e the time required to attain first minimum of energy density of the corresponding perturbed mode (also called phase mixing time for $k \rightarrow 0$ modes) versus ion inhomogeneity amplitude A have been obtained from both kinetic and fluid solutions for each of the cases studied, alongwith some major differences in τFM scaling for small system sizes.

Quasi-Longitudinal Propagation of Nonlinear

Whistlers with Steep Electrostatic Fluctuations: The quasi-longitudinal whistlers are recently reported in magnetized laboratory plasmas, i.e., at densities considerably higher than the space or magnetospheric plasmas. Given their oblique nature, these whistlers are known to be accompanied by density perturbations which undergo strong nonlinear steepening exclusively for their propagation close to resonant cone angle. This aspect is examined in the parameter regime of laboratory experiments where quasi-longitudinal whistler fluctuations are reported. A systematic study by a set of dedicated single mode numerical solution of the fully nonlinear model of quasi-longitudinally propagating whistlers is presented predominantly covering the high-density (low magnetic field) regime relevant to the laboratory whistler experiments. Following the recovery of existing computational results available for low-density cases, the computations in the newer regime are performed in the present study. The evolution recovered in both these regimes finds sharp density structures or oscillations to be of resonant origin. While structures accompanying the whistlers' low-density resonant cone readily agree with the upper hybrid resonance frequency, the freshly covered high-density regime shows that the strong nonlinear nature of the whistler is capable of producing a modification in the resonant frequency, causing it to downshift from its linearly expected upper hybrid frequency.

Effect of Radiation-Reaction on Charged Particle Dynamics in a Focused Electromagnetic Wave: The effect of radiation-reaction force on the dynamics of a charged particle in an intense focused light wave is investigated using the physically appealing Hartemann-Luhmann equation of motion. It is found that, irrespective of the choice of initial conditions, radiation reaction force causes the charged particle to cross the focal region, provided the particle is driven into regions where the radiation reaction force dominates over the Lorentz force, thus enhancing the forward energy gained by the particle from the intense light wave. This result is in sharp contrast to the well-known result, derived in the absence of radiation reaction forces, where for certain initial conditions the particle reflects from the high intensity region of the focused light wave, thereby losing forward energy. From the perspective of energy gain, the studies clearly show that the parameter space for forward energy gain which is reduced by ponderomotive effects is compensated by radiation reaction effects. These results, which are of relevance to the present day direct laser acceleration schemes of charged particle, also agrees with that obtained using the well-known Landau-Lifshitz equation of motion.

Study of Two-Electron Temperature Plasma Sheath Using Non-Extensive Electron Distribution in Presence of an External Magnetic Field: In this study, the physics of sheath formation in a collisional two-electron temperature plasma in the presence of an oblique external magnetic field has been investigated. At first, a comparative study among the fluid electron model, Boltzmann electron model, and the non-extensive electron model has been carried out and a suitable range of non-extensive parameter 'q' has been predicted. In the latter part, a collisional two-electron temperature plasma is considered. Both the hot and cold electron densities are described using the non-extensive distribution, whereas cold ions are described by the fluid equations. The properties of the sheath are investigated in different collisional regimes by varying the non-extensive parameter (q) and the hot to cold electron densities and temperatures. The magnetic field inclination angle is varied in the limit $1° \leq \alpha \leq 5°$. It is observed that electron distribution significantly deviates from Boltzmann distribution for nearly parallel magnetic field. Moreover, collision enhanced flux deposition for highly magnetized

case is a significant finding of the study. The results obtained in this study can enhance the understanding of plasma–matter interaction processes where multiple electron groups with near parallel magnetic field are found.

Observation of Double Layer Formation in Low-Temperature E × B Plasma Based Negative Ion Sources: In this study, formation of a double layer (DL) is studied in the background plasma (considering only electrons and ions) in the presence of a magnetic field in the context of the RF operated beam source in India for negative ion research negative ion source by using 2D-3V particle-in-cell Monte Carlo collision kinetic simulations. A rectangular geometry to model the source, expansion, and magnetic filter regions in the negative ion source is considered in the XY plane. A Gaussian shaped magnetic field is applied in the Z-direction (perpendicular to the simulation plane), and a bias voltage is applied on the extraction boundary. The simulations show the presence of instabilities as reported in the literature. Further the formation of a weak DL in the magnetic filter region under some specific combinations of the magnetic field and bias voltage is also confirmed. Initiation of DL leads to ion acceleration in the magnetic filter region. Split in ion velocities are also visible in the phase space plots due to the presence of free and trapped ions in the DL region. This study highlights the effect of DL on plasma transport, which should be taken into account when interpreting the experimental observations associated with E × B plasma based negative ion sources.

Modulational Instability of a Yukawa Fluid Excitation under the Quasi-Localized Charged Approximation (QLCA) Framework: Collective response of a strongly coupled system departs from that in continuum phase upon transition to the quasi-crystalline phase, or a Wigner lattice. The nonlinearity driven modulational instability, for example, of a quasi-crystalline dusty plasma lattice wave, is predicted to inevitably grow macroscopic envelope structures at the expense of a mesoscopic carrier wave. The modulational instability in the dimensionally extended quasi-crystalline or amorphous phase of a strongly coupled system, uniquely accessed by the quasi-localized charge approximation (QLCA) formulation, is shown to offer conditional stability over the entire range of spectral scales by prescribing a narrower instability regime. In distinction from the excitations of linear one-dimensional chain of strongly coupled dust grains, the longitudinal modes of a quasi-crystalline phase incorporated by means of a pair correlation function in the present QLCA based treatment shows the lattice excitations to be stable for arbitrarily long wavelengths beyond a finite value of screening parameter $\kappa = a/\lambda_D = 0.182$ at low enough temperature, where 'a' is the inter dust separation and 'λ_D' is the plasma Debye length. However, this unstable domain of the parameter space does grow with increase in the dust temperature which invokes the weak coupling-like effect. The present results show that in comparison to the one-dimensional chains, the dimensionally extended strongly coupled lattice are potentially stable with respect to the macroscopic amplitude modulations. Results offer a greater handle over the macroscopic structures growing from the mesoscopic fluctuations, a mechanism which underlies a variety of processes, ranging from the barrier formation in strongly coupled turbulence to the highly localized modification, induced by collective excitation, of the ultracold ions trapped in strong electromagnetic fields. The existence of the growth rate of instability as well as the maximum modulational growth rate of instability has been investigated for a wide range of values of the screening parameter.

Particle In Cell (PIC) Simulation of Electrostatic

Waves in the ionosphere: In the space atmosphere, plasma with two electron components is very common. The cold species of electron (Te ~ 1 eV) usually originate in the ionosphere, while, the hot electron species (Te ~ 100 eV) appear from the magnetosphere. In addition, there may be a beam of electrons streaming along the magnetic field lines. These electrons are responsible for exciting various electrostatic wave modes. While the beam strikes various electrostatic wave modes in the ionosphere, its non-linear nature of kinetic energy sharing is especially important. The interactions are responsible for the Broadband Electrostatic Noise (BEN). The beam not only gives away its energy share, but also receives back from the background hot and cold electrons. A general trend portrays the fact that the retrieval is more as the beam energy is higher. However, although this is commonly observed, there are exceptions. The Particle-In-Cell code "SPIC" used for the investigation has been developed indigenously and tested for benchmarking problems. The code is energy conserving which is apparent from the energy conservation plot. In addition to the investigation of kinetic energy, various electrostatic wave modes such as the electron plasma wave, electron acoustic wave and the electron beam wave has been studied.

Plasma Sheath with Two Species of Positive Ions and Surface Produced Negative Ions: The structure of a plasma sheath has been investigated in front of a caesium coated metallic plate, using a simple theoretical model. Along with the electrons, the plasma is composed of two species of positive ions, and surface and volume produced negative ions. While the volume produced negative ions are common in many plasma processing chambers, the surface produced negative ions are of critical importance to Neutral Beam Injection (NBI) systems. The surface negative ions are produced via the coated metallic plate. With a single species of positive ion, the Bohm criterion which determines the sheath edge potential is multi-valued for a specific range of electronegativity (α_0). The width of the multi-valued region has been reported to increase with the surface production yield (δ), where, δ is the parameter that governs the production of the surface negative ions based on the corresponding flux of positive ions. The likelihood of a second positive ion species in NBI systems cannot be ignored. Besides discussing the differences brought in by the presence of such a second ion, the work highlights the importance of the positive ion current density in determining the Bohm criterion.

Complex Mode Dispersion Characteristics of Dielectric loaded Radially Thick Helix: The complex mode EM Wave dispersive characteristics of Dielectric loaded radially thick helix (DLRTH) which shows slow wave (SW), backward wave (BW) and leaky wave modes characteristics is observed.

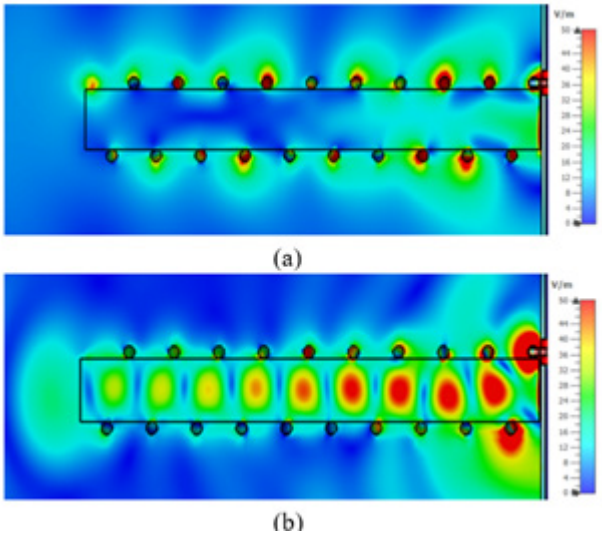

Figure A.5.8: Electric field distribution for ε_r= 4.3 (a) Leaky mode (b) Guided mode.

The Eigen-mode equations are solved analytically, numerically and computed using EM Wave solver CST Microwave Studio to visualize HE and EH

hybrid modes behavior separately (Fig. A.5.8). The two distinguish characteristics and applications of the proposed DLRTH structure are found. The first one is that it supports slow wave propagation having phase velocity ten times less than velocity of light which finds potential application in slow wave (phase delay) devices and phase filters. The second feature is that it supports a wide leaky mode region, which can be controlled by pitch angle, which finds application in beam steering based Leaky Wave antennas system. In the leaky mode configuration, the wave leaks from the gap of the helix in the perpendicular direction and gets attenuated along the axial direction. However, in the guided mode, the wave stays restricted within the structure, propagates along the axial direction and radiates energy along the end fire direction due to discontinuity at proposed aperture.

A.5.5 Laser Plasma Interaction

Laser cluster interaction in ambient magnetic fields for accelerating electrons in two stages without external injection: In this theoretical study a significant (>30 fold) enhancement of laser absorption is shown in figure A.5.9. This has been achieved by electrons from a deuterium nano-cluster in presence of ambient magnetic fields B_{ext} using a simple model of cluster (RSM). Rigorous particle-in-cell (PIC) simulations with a 5-fs broadband laser pulse has been observed. This work may ignite new interest for energetic electron generation, particularly with the availability of new generation of broadband lasers and upcoming new magnetic field technology. Moreover, it may improve understanding of the origin of energetic electrons in astrophysical plasmas, e.g., in the environment of neutron stars and pulsars where ambient magnetic fields may range $\approx 10 - 100000$ kT along with a wide range of electromagnetic fields. PIC results are justified by RSM. External magnetic field assists more laser energy absorption.

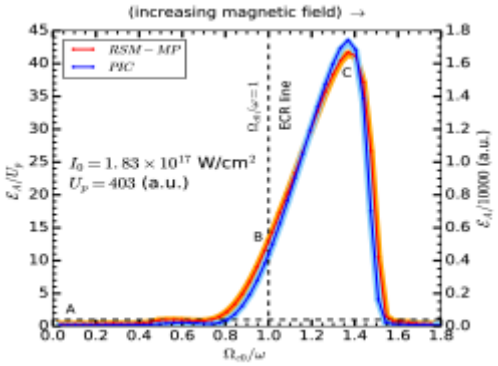

Figure A.5.9: Average absorbed energy per electron ℰA vs its normalized cyclotron frequency Ωc0 from a laser-driven deuterium nano-cluster with increasing external magnetic field. Absorption is less than Up for negligible external magnetic field (at point A) while it is 12Up and 43Up at points B (for ECR, electron cyclotron resonance) and C respectively.

Laser Intensity Profile Based Terahertz Field Enhancement from a Mixture of Nano-Particles Embedded in a Gas: Nano-particle embedded system plays an importance in developing of future terahertz (THz) radiation source for real-world applications. The laser interactions with nanoparticle embedded system can produce a wide range of THz radiation due to plasma oscillation excitation. In this work THz field generation from the laser-beat wave interaction with a mixture of spherical and cylindrical graphite nanoparticles in argon gas has been studied. Different laser intensity distributions such as Gaussian, cosh-Gaussian, fat-top and ring shape laser pulses have been studied. THz field is enhanced up to the order of 10^2 when the laser intensity redistributes along the polarization direction for a ring shape field envelope.

Mode Conversion and Laser Energy Absorption by Plasma under an Inhomogeneous External Mag-

netic Field: The interaction of a high-frequency laser with plasma in the presence of an inhomogeneous external magnetic field has been studied with the help of particle-in-cell simulations. It has been shown that the laser enters the plasma as an extraordinary wave (X-wave), where the electric field of the wave oscillates perpendicular to both the external magnetic field and propagation direction and as it travels through the plasma, its dispersion property changes due to the inhomogeneity of the externally applied magnetic field. The study shows that the X-wave's electromagnetic energy is converted to an electrostatic mode as it encounters the upper-hybrid (UH) resonance layer. In the later stage of the evolution, this electrostatic wave breaks and converts its energy to electron kinetic energy. The study also reveals two additional processes involved in decay of the electrostatic mode at the UH resonance layer. It is seen that the energy of the electrostatic mode at the upper-hybrid resonance layer also converts to a low-frequency lower-hybrid mode and high-frequency electromagnetic harmonic radiations. The dependence of energy conversion processes on the gradient of the external magnetic field has also been studied and analyzed.

Localized Absorption of Laser Energy in X-Mode Configuration of Magnetized Plasma: The heating of ions via lower hybrid (LH) waves has been observed in several astrophysical as well as laboratory plasmas. Particle-in-cell simulations have been performed in this study to demonstrate absorption of the incident laser pulse at a chosen localized point in the plasma target by manipulating its density profile. It is seen that a part of the incident laser propagates inside the plasma target when its frequency lies below the LH resonance frequency. Thereafter, as it experiences a negative density gradient, it approaches the resonance point where its group velocity approaches zero. This is where the electromagnetic (EM) energy prominently gets converted into the electrostatic and eventually the kinetic energy of ions. Thus, by tailoring the plasma density profile one can have the absorption of incident EM wave energy at a designated location inside the plasma. This may be important in various applications where energy deposition/heating of plasma in a localized region is desirable.

A.5.6 Dusty and Complex Plasmas

Dust-Ion Acoustic Solitary Waves in a Collisionless Magnetized Five Components Plasma: In this work Korteweg–de Vries–Zakharov–Kuznetsov (KdV-ZK) equation has been derived to study the nonlinear behaviour of dust–ion acoustic waves in a collisionless magnetized five components dusty plasma consisting of warm adiabatic ions, nonthermal hot electrons, isothermal cold electrons, nonthermal positrons and static negatively charged dust particulates. It is found that the coefficient of the nonlinear term of the KdV-ZK equation vanishes along different family of curves in different compositional parameter planes. In this situation, to describe the nonlinear behaviour of dust–ion acoustic waves, a modified KdV-ZK (MKdV-ZK) equation has been derived. When the coefficients of the nonlinear terms of both KdV-ZK and MKdV-ZK equations are simultaneously equal to zero, a further modified KdV-ZK (FMKdV-ZK) equation has been arrived at which effectively describes the nonlinear behaviour of dust–ion acoustic waves. Analytically and numerically, the solitary wave solutions of different evolution equations propagating obliquely to the direction of the external static uniform magnetic field have been investigated. It is seen that the amplitude of the KdV soliton strictly increases with increasing βe, whereas the amplitude of the MKdV soliton strictly decreases with increasing βe, where βe is the nonthermal parameter associated with the hot electron species. Also,

there exists a critical value of βe such that the FM-KdV soliton exists within a particular the interval, whereas the FMKdV soliton does not exist within the interval between 0 and its critical value. This study also involves the effects of different parameters of the system on solitary waves obtained from the different evolution equations.

Study of Magnetized Multi-Component Plasma Sheath Containing Charged Dust Particles in Presence of Oblique Magnetic Field: A Fluid Approach: The dynamics of low-temperature magnetized multi-component dusty plasma sheath structures have been investigated with finite ion temperature in presence of an oblique magnetic field using the one-dimensional multi-fluid model. The parametric changes inside the sheath are estimated in presence of charged dust species having nano-meter (nm) sizes. In presence of charged dust inside the sheath, the ions are found to accumulate near the sheath edge, hence the ion density is decreased towards the wall. Further, with the increase in magnetic field strength, the peaking of ion densities near the sheath edge has been found to intensify. The magnetic field orientation also plays a crucial role in the bunching of the ions near the sheath edge. An increase in the magnetic field obliqueness contributes to intensifying the ion bunching. It has also been observed that the sheath potential is substantially changed. In addition, the influence of dust species presence on the electron density inside the sheath has also been investigated to arrive at a qualitative explanation of the phenomenon that occurs due to the presence of dust species.

Investigation of Dust Ion Acoustic Shock and Solitary Waves in a Viscous Dusty Plasma: A viscous dusty plasma containing Kappa distributed electrons, positive warm viscous ions, and constant negatively charged dust grains with viscosity have been considered to study the modes of dust-ion-acoustic waves (DIAWs) theoretically and numerically. The derivations and basic features of shock and solitary waves with different plasma parameters like Mach number, finite temperature coefficient, unperturbed dust streaming velocity, the kinematic viscosity of dust, etc of this DIAWs mode have been performed. Considering the dynamical equation from Korteweg-de Vries (KdV) equation, a phase portrait has been drawn and the position of the saddle point or col. and center have also been discussed. This type of dusty plasma can be found in celestial bodies. The results of this research work can be applied to study the properties of DIAWs in various astrophysical situations where κ-distributive electrons are present and careful modification of the same model can help us to understand the nature of the DIAWs of laboratory plasma as well.

A.5.7 Artificial Intelligence and Machine Learning

Impact of Local Timescales in a Cellular Automata Model of Excitable Media: A cellular automata system known as the Greenberg-Hastings cellular automata (GHCA), with cyclic and excitable individual dynamics, provides a useful paradigm for modeling emergent phenomena in an excitable medium. Most past studies of GHCA have investigated the asymptotic dynamics of the system, assuming fixed extents for the active and passive dynamical phases. This study is a systematic investigation of the relationship between the dynamical properties of individual cells of a small system implementing excitable dynamics, and the emergent system wide asymptotic state. The impact of the temporal extents of individual dynamical phases (τa, τp), on the probability of persistence P(τa, τp), defined as the fraction of initial configurations which sustain spatiotemporal oscillations asymptotically, is examined for each unique configuration of the sys-

tem. The main result obtained is that the probability of persistence P(τa, τp) assumes a characteristic sigmoidal form, as the dynamical behaviour of the system transitions from absolute quiescence to persistent spatiotemporal oscillations, with respect to the parameters (τa, τp). A plot of the numerical findings in the (τa, τp) space provides a consolidated view of their impact on the emergent behaviour of the system. The study helps to understand some implications of the methods and results obtained in this work, to the study of emergent phenomena in excitable systems.

Analysis of effective thermal conductivity of pebble bed by artificial neural network and its computational and experimental verification: Lithium ceramics are used as the tritium breeder material in the fusion blanket. ITER, an experimental fusion reactor is under construction in France where these lithium ceramics will be used in the Test Blanket Module (TBM). Breeding blankets in a fusion reactor have to breed the tritium required for D-T reaction and to convert nuclear energy into heat extracted by a coolant. In order to design a breeder blanket, the detail heat transfer phenomena of the pebble bed, both experimental and simulation are essential. Sometimes, experiments and simulations are time and resource consuming. Hence, ANN (Artificial Neural Network) may be used to predict the behavior of the system as a complementary approach of simulation and experimental analysis. ANN Model has been adopted to solve the basic heat transfer problem in Pebbles and its outcome in terms of matching of ANN Model with experimental data has to be spelled out to show that compatibility of ANN Model (Fig. A.5.10).

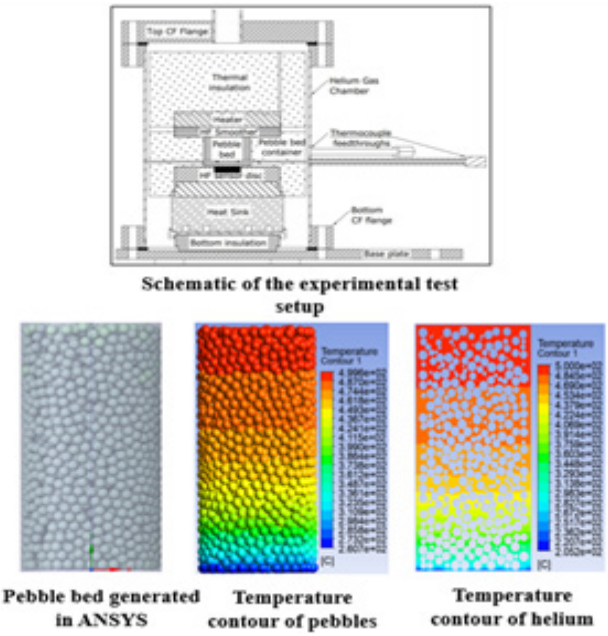

Figure A.5.10: Schematic of experimental test setup and simulation data.

IPR X-ray digitizer for AI4TB India: In the ongoing project with ICMR and other hospitals/medical colleges from all zones of India (Fig. A.5.11) for AI4TB program.

Figure A.5.11: The 19 sites using institute's digitizer across India.

A large number retrospective data in the form of X-rays are available which can be digitised to support the AI based DeepCXR development program. The digitised data eases tele-consultation and faster diagnosis and can be a key to ease out imbalance of experts/radiologists in rural places. The digitizers are now being used by the participating hospitals/medical colleges to digitize the retrospective and prospective data (CXR). The data are uploaded in the ICMR central data server and serve as the required database for development of AI software under this program.

DeepCXR: Development and Validation of Artificial Intelligence Tool For Screening/detection of Pulmonary TB and other lung diseases using Chest X-rays: To cater the need of a general AI software that would work for India a central data server has been rigged up at ICMR Delhi with website https://tb.ai.icmr.org.in/ai4tb/ in collaboration with the institute.

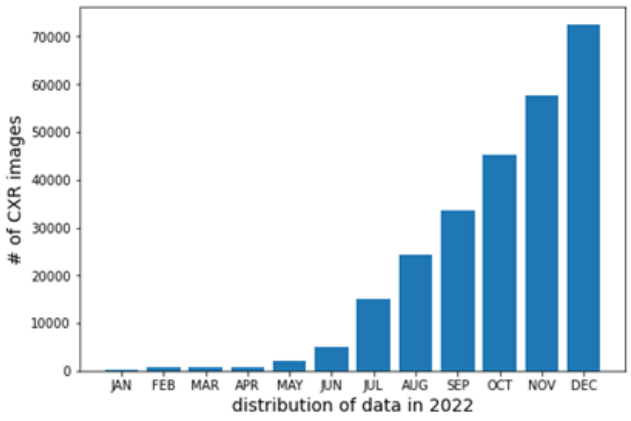

Figure A.5.12: The distribution of data and the no. of CXR Images.

The uploaded data in the form of digitised X ray images comprises data set from confirmed cases of TB by Gold Standard Test (microbiological or clinical) and covers the geographic differences (rural and urban, plain and plateau etc.), gender, and socio-economic status across 4 zones of India. Till date ~73000 such data have been uploaded, figure. A.5.12. The AI software is being used to test the data being received at ICMR Delhi headquarters from Saharia Tribe, one of the remotest region in Madhya Pradesh, India. The validation & testing for Normal/abnormal Chest-X ray shows that the specificity & sensitivity is > 94 % on this data set which was not a part of the data set used to train the software. The AI software is now being enhanced for identifying further classes of TB e.g. cavitory, pleural diffusion Infiltration, fibrosis with data from all sites. Further development to identify NORMAL X-rays with high confidence and validation of DeepCXR with prospective data from all participating sites is underway.

Understanding the Surface Wave Characteristics Using 2D Particle-In-Cell Simulation and Deep Neural Network: The characteristics of the surface waves along the interface between a plasma and a dielectric material have been investigated using kinetic particle-in-cell simulations. A microwave source of GHz frequency has been used to trigger the surface wave in the system. The outcome indicates that the surface wave gets excited along the interface of plasma and the dielectric tube and appears as light and dark patterns in the electric field profiles. The dependency of radiation pressure on the dielectric permittivity and supplied input frequency has been investigated. Further, the capabilities of neural networks to predict the radiation pressure for a given system have been assessed. The proposed deep neural network model is aimed at developing accurate and efficient data-driven plasma surface wave devices.

CHAPTER B

INTERNATIONAL COLLABORATIONS

B. International Collaborations

Apart from in-house activities, the institute is also actively participating and contributing to the following major international mega science experimental collaborations like ITER and laser interferometry gravitational wave observatory (LIGO) setup as equal partner in designing, fabricating, testing and supplying various systems and subsystems.

B.1 Activities of ITER - India

ITER India continues its steady progress towards fulfilling ITER commitments. While installation work progresses at the ITER France site with the Indian supplies related to cryostat, cooling water system, in-wall shields and the Cryolines, R&D efforts continue in the various labs at ITER India-IPR for packages related to ICRH, ECRH, DNB, diagnostics and the power supplies. Till date ~85 % of work related to various installations at the ITER site has been completed.

The following sections provide a brief and pictorial summary of the progress in terms of supplies, manufacturing, technology development and experimentation related to the various packages under the scope of ITER India.

<u>*Cryostat:*</u> Having successfully completed the deliveries of various sections of the cryostat efforts are now focused to ensure the timely delivery of the ITER Torus Cryopump Housing (TCPH) (Fig. B.1.1) which is also a part of the INDIA scope of supply under cryostat procurement arrangement. TCPH Housing is a penetration located on the Cryostat lower cylinder with main functions to accommodate and support the Torus Cryo-Pump (TCP), connect it to the Vacuum Vessel and provide tritium confinement.

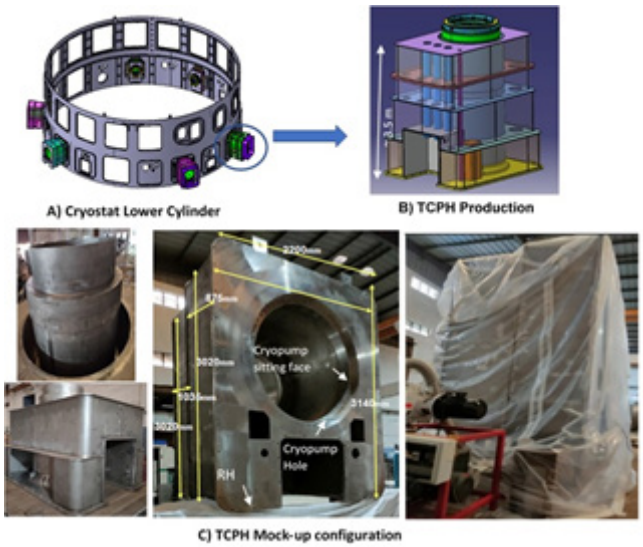

Figure B.1.1: Half sized TCPH module fabricated, assembled and tested at M/S Vacuum Techniques, Bangalore.

The manufacturing contract for TCPH and associated bellows (6 Nos.) has been placed with M/s Vacuum Technique Pvt Ltd., Bangalore.

Half sized mock ups (Fig. B.1.2) have been fabricated to validate some of the important require-

ments related to:

• Welding and NDE validation for production that ensures weld configuration with 100% volumetric inspect-ability on full penetration weld joints using GTAW welding process

• Assembly sequence to ensure required access suitable for manufacturing including validation of welding shrinkages that controls the distortion during the production.

• Achievement of critical functional tolerances (flatness of cryopump flange sitting face machining achieved within 0.12 mm , cryopump bolting hole positions within 0.3-0.8 mm also dowel positions achieved in the range of 2.0-2.4 mm.

• Achieving the desired leak rates of ~ 1.6 x 10^{-8} mbar l/s.

Figure B.1.2: Various sub-assemblies of the TCPH ; full size production.

The above resulted in establishing the production route of the full sized TCPH assembly. Till date 3 sub-assemblies of Type A have been completed where as those for types B, C and D are underway at the 80% mark (Fig. B.1.2). In addition the manufacturing of the TCPH bellows has been completed and final leak testing is in progress at the sub-contractors site.

As far as the ITER cryostat instrumentation is concerned, the factory acceptance tests of all the signal conditioning cubicles has been completed at the works of M/S L&T and shipped to ITER Organisation.

Cooling water system: The Indian scope of supply of the cooling water system at ITER consists of Component Cooling Water System (CCWS), Chilled Water System (CHWS) and Heat Rejection System (HRS). This year marked the completion of the Stage-II of the engineering & procurement contract. A 'Commit to Deliver (C2D)' event was organized by ITER Organization at ITER site on 16th June 2022 to mark the installation and completion of the supply of various equipment's under this procurement. In addition to the above, a Task Agreement involving the manufacturing of three safety-important Hydrogen Mitigation System vessels namely, Pool Scrubber Tank (PST) (Fig. B.1.3), Quench Tank (QEN) and Overflow Tank (OFT) along with the common support frame is completed. The vessels have been accepted by ITER Organization (IO) after successful testing.

Figure B.1.3: Pool scrubber tank PST under lifting test and packed for shipping at the manufacturer's site.

Further as a follow up of the installation, the activities at ITER IO are continuously supported for resolution of any issues in the commissioning of supplied components. Also as a part of agreement with IO to support the design of CHWS-H1, several design activities including process design, hydraulic analysis, seismic qualification of pumps, pressurizers, and chillers have been completed.

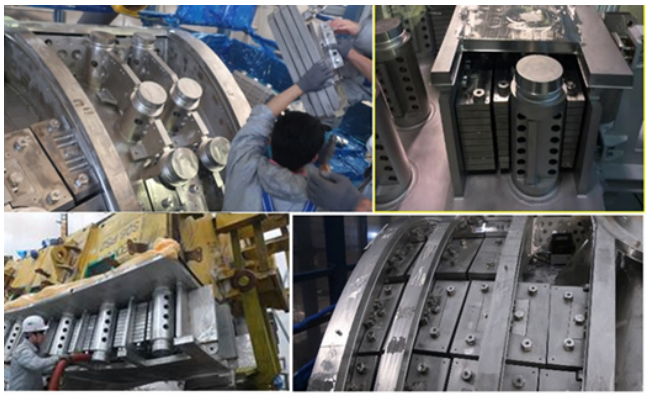

Figure B.1.4: In sequence : IWS lowered for assembly in VV sector, IWS assemble around flexible support housing between outer and inner shells of VV, inspection after assembly to ascertain needed clearance, VV segment view after assembly of IWS and ready for welding the outer shell.

<u>In wall shields:</u> The in-wall shield blocks supplied by INDA have been installed in 5 vacuum vessel sectors at EUDA and 4 vacuum vessel sectors at KODA. Figure B.1.4 shows some snapshots of such assemblies.

<u>Cryoline and cryodistribution system:</u> After 100% manufacturing and supply of Cryolines to ITER in last year, steady progress continues towards the installation of the Cryolines of various categories at ITER site. Onsite installation of 63% of the X Cryolines, 68% of the Y Cryolines and 73% of the warm lines has been completed. In addition provisional acceptance of 5 lines has been successful. Figure B.1.5 shows the snapshots of installation of various categories of warm and cold lines under installation at ITER France.

Figure B.1.5: Installation of X, Y cryolines and warmlines at ITER site.

Steady progress also continues towards ensuring the manufacturing completion of the auxiliary cold boxes (ACB). The factory acceptance tests of ACB-CP, ACB-1, ACB-2 and ACB-5 have been completed. Further, integration with interfaces and acceptance tests of CTCB is underway at the ITER cryoplant cold box building.

<u>Diagnostic neutral beam system:</u> Diagnostic neutral beam (DNB) system is based on the roadmap of development encompassing beam production and optimization experiments at the ROBIN and TWIN test beds mentioned under NNBI section and several aspects of technology development towards achieving an operational INTF which is a full scale prototype of the DNB system with some of the components on loan from ITER. Steady progress continues related to the manufacturing of the components and in preparing the INTF test bed for beam operations. Majority of the parts of the DNB beam source have been completed. Adaption of changes on the ion source design emerging

out of the NBTF SPIDER experimental test bed as proposed by ITER are underway. The factory acceptance tests of the manufactured and assembled beam line components(Fig.B.1.6), viz. the neutralizer, and the electrostatic Residual Ion Dump (RID), were completed in Feb 2023.

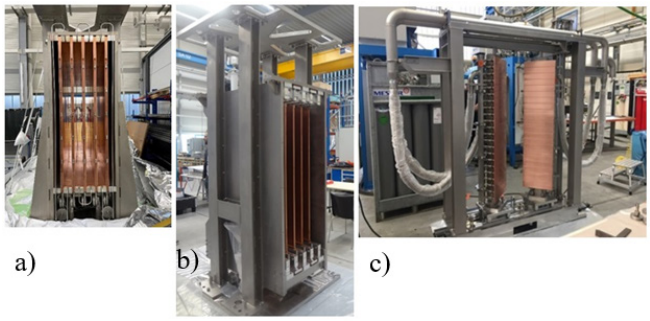

Figure B.1.6: DNB beam line components a) neutrailser, b) RID, c) calorimeter.

The components will be shipped to ITER India after completion of Delivery Readiness Review (DRR) and the site acceptance tests at INTF test bed will follow to close the contract. Figure B.1.6a shows a 3 m long, 1.8 m high, 17 tonne, panel Neutraliser for DNB. Each panel is an assembly of consisting of 1 m long subpanels 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). Figure B.1.6b shows 1 m long, 1.8 m high, 5 tonne, 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. Figure B.1.6c shows 1.8 m high, 3 tonne, 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. Special feedthroughs have been designed and developed to enable opening and closing of the two panels.

Ion cyclotron resonance frequency heating sources: After the successful demonstration of the 1.5 MW RF amplifier chain in the recent years, efforts continue towards doing the needful to demonstrate 3MW RF power per source by combining RF outputs from 2 amplifier chains through an indigenously developed combiner circuit. In addition indigenous developments continue to reduce import dependence to the extent possible. As a step towards this, pre dispatch inspection of mechanical sub-assemblies for the Indian made driver amplifier has been completed which included assembly and tests for mechanical integrity. Several technology areas related to capacitor development, use of thermally conductive epoxy based adhesive to join Al and brass plates and silver plating on brass and phosphor bronze cylindrical conductors were addressed during the course of this development. Low power RF tests shall be initiated in the next phase followed by high power RF test to establish the performance of the developed amplifier.

Another important indigenous development relates to development of a 12-inch 3 MW Mismatch Transmission line (MMTL) system (Fig.B.1.7). The system has been successfully manufactured and assembled to enable for matched and mismatch testing of 3MW RF source with minimum Tx-line changeover time. The main 12-inch components of this system include box- type phase shifter, stub, directional coupler, SPDT switch, gas barrier and straight & elbow Tx-lines. The next phase aims at series of low power and high power tests.

Figure B.1.7: Indigenous development mismatched transmission line (MMTL) system.

Further development of a 10 kW Solid State Power Amplifier (SSPA) has progressed with the PA1 module fully assembled with a pair of pallets and lumped combiner. In addition to these water cooled bleeder circuits for auxiliary power supplies and fast acting series switches for screen grid power supply have been developed and tested.

ECRH system: One of the important developments of this year include successful completion of the site acceptance tests for a 170 MHz Gyrotron unit procured from Russia and integrated with the indigenously developed experimental test bed at ITER India lab (Fig. B.1.8). An average peak power of 1 MW for 1000 s at the output of the diamond window and 960 KW at the output of Matching Optic Unit has been achieved for 5 pulses and complies with the specified value for the Gyrotron output power. It is also noted that the output frequency of the Gyrotron, measured using a spectrum analyser setup, is well within the specified range of 170 GHz +/- 0.3 GHz. This is a significant achievement as far as the Indian scenario is concerned. The RF efficiency is estimated at the Gyrotron window output and is found to be compliant with the specified value of 50%. More detailed tests such the reliability tests, modulation tests and some dependency tests etc. have also been carried out within the test facility limitations.

Figure B.1.8: The gyrotron test bed at ITER India laboratory.

Power supply systems: A PSM topology based Main High Voltage (55kV, 6MW) Power Supply (MHVPS) has been developed for the Gyrotron test facility of ITER-India, IPR. MHVPS is capable of feeding settable voltage with ±0.5% accuracy from 10kV to 50kV. In-house developed Zynq 702 based controller is deployed for control, regulation and fast switch off; <10μs in case of short circuit. Operation GUI runs on Siemens PLC 1500. MHVPS has been successfully integrated for performing Site acceptance test of 1MW Gyrotron at ITER-India lab. MHVPS supported conditioning, short pulse requirements and subsequently delivered the required power for 1000seconds operation (Fig. B.1.9). Without any interruption, MHVPS supported reliability test (10 successive pulses of 500s) of 1MW Gyrotron including RF power modulation at 1 kHz. The facility at ITER-India lab is among the few where 1MW Gyrotron operations are being conducted.

Integrated operation of HVPS during SST-1 cam-

paign achieved feeding of 1.6 MW power at 60 kV to Klystron of LHCD system. Remote operation was successfully carried out for required power with time synchronisation and load protection. Recently, 3MW HVPS was also utilised for validation, initial operation of integrated IC RF source at SST-1.

Further, 7.2MW, 100kV AGPS supplied by ITER-India has successfully completed 3 years of integrated operation on SPIDER experiments at NBTF, Padua, Italy site with remote support from ITER-India. AGPS is an in-kind supply under ITER package manufactured by M/s. ECIL.

An upscale version of 200kW SSRFG (1MHz) is being developed under contract with M/s. ECIL, where design approval is given for manufacturing of SSRFG.

Diagnostics: Parallel developments continue on several diagnostics to be supplied to ITER France which include systems for XRCS survey diagnostic, XRCS edge diagnostic, CXRS pedestal diagnostic system and the ECE diagnostic system. The highlights are design development and testing for X rays and physics design and ray tracing of the Bragg X ray spectrometer and high resolution X ray spectrometer for the XRCS survey and edge diagnostic systems respectively. Factory testing of the fibre bundle assembly for the CXRS pedestal diagnostic is in progress. The development related to ECE diagnostic systems relates to measurement of the insertion losses for the polarizer splitter, and design of the 170 GHz sensor for stray RF radiation protection system are also being carried out.

Modelling activities: Modelling for ITER Disruptions, Vertical Displacement Events (VDEs), runaway electrons and their mitigation has been continued with the TSC code. New simulations are being performed with Tungsten impurities as ITER Organization has proposed to change the first wall armour material from Beryllium to Tungsten. The initial simulations show much faster current quench times in presence of W impurities.

Activities of the knowledge management group: The Knowledge Management group, now comprising of 12 members, has been studying and storing necessary documentation for the ITER systems of Vacuum Vessel, Magnets and their power supplies, Blanket /Modules, Divertor Cassettes, Remote handling and Buildings. The documentation is being stored systematically in INDUS documentation system of ITER-India, which will be invaluable for

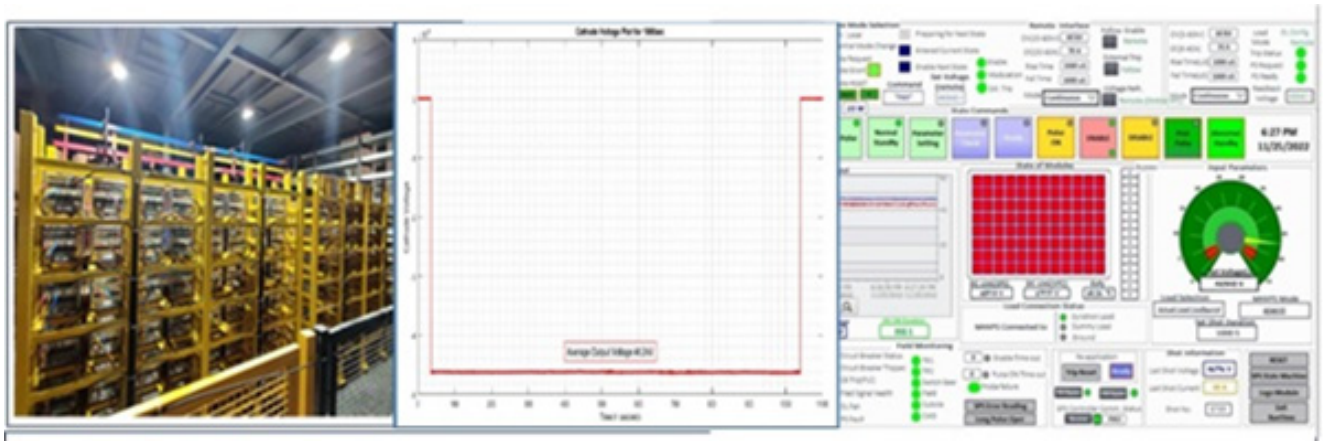

Figure B.1.9: MHVPS operation with 1MW Gyrotron, delivering power for 1000s duration.

future Fusion reactors to be built in India.

HR Development: Keeping into consideration the fact that Indian participation in ITER also aims at enhancing its domestic fusion program, the Empowered Board approved a proposal to depute Institute's research scholars for joint research work in collaboration with scientists in ITER. As ITER shall enter into its next phase of operations in the coming years, understanding the operation scenarios and learning various aspects of plasma behavior and control and power coupling for such scenarios is an important part of the training required to operate such machines. The HR development program aims at encouraging the participation of young researchers in areas related to theoretical/computational/experimental problems relevant to tokamak operations and also in the areas of relevant fusion technologies.

To begin with 3 research scholars from the institute have been deputed to ITER. The areas of work are an extension of the problems which these scholars have been pursuing as a part of the PhD program at the institute. The students work under the guidance of ITER researchers and in consultation with the institute guides for this program in a collaborative approach. Efforts are underway to establish a MoU between HBNI and ITER Organization to enable participation of a wider spectrum of students in the coming years. In the coming years if the need be similar MoU's can be established with other relevant labs pursuing research in the areas of experimental and theoretical plasma physics and fusion relevant material and technology developments.

B.2 Laser Interferometry Gravitational Wave Observatory (LIGO - India)

LIGO-India project is mandated to construct, install, commission and operate a 4 km long laser interferometer based Gravitational Wave detector in India in collaboration with LIGO Laboratory, USA. The LIGO India project is being jointly executed by four leading institutes of India named RRCAT Indore, IPR Gandhinagar, DCSEM Mumbai and IUCAA Pune. About 22 sites across the country were initially identified and surveyed for locating the project. The search zeroed down to Aundha, near Hingoli in Maharashtra.

The LIGO Division at the institute, is responsible for following contributions.
1. Verify design, procure, install and commission 10,000 m^3 vacuum system operating in UHV ($\approx 10^{-9}$ mbar) range and essential for functioning of LIGO India detector. The procurement also includes vacuum equipment and accessories essential to operate, monitor and control integrated vacuum system
2. Design, develop, install and commission a Control and Data System (CDS) for LIGO India.

Activities towards development of Vacuum and Mechanical systems: Outgassing measurements are necessary to establish hydrogen outgassing property of the stainless steel raw material considered for the fabrication of LIGO-India beam tube. Test coupons of steel cut from raw material and air baked at 440 ^{0}C will be tested to establish the hydrogen outgassing rate of $< 10^{-14}$ mbar l/s/cm^2. An outgassing measurement system with few upgrades (Fig. B.2.1) has been setup this year in LIGO India – Vacuum Integrated Test Assembly (LI-VISTA) facility at the institute to enable these measurements. The integrated system is helium leak tested to $1x10^{-10}$ mbar.l/s. The system is currently being vacuum baked to 150 ^{o}C to improve on its vacuum

performance. Trials related to insertion of ~150 number of coupons from different ports followed by vacuum tests in the 10^{-8} mbar range have been carried to ascertain the functionality of the system.

Figure B.2.1: Outgassing measurement set up.

In addition to the above, procurement contracts for supply of 20m Integrated Vacuum Vessel and 80K Cryo-pump assembly were awarded two Indian companies. In 80K Cryopump contract the Manufacturing Readiness Review (MRR) has been conducted recently. The Inspection of gate valves from HTC has been completed at an Indian industry premises. The review of various input documents from sub-contractors of Bellows, Dished ends, and spring etc. is also completed. The controls system layout schematic of 80K Cryopump is also reviewed and finalized. As regards the 20m (2 x 10 m) Integrated Vacuum Vessel Contract the vacuum vessel manufacturing is in progress with various mock-up activities been performed to establish the manufacturing route (Fig. B.2.2). The conceptual layout of various SCADA screens in line with vacuum system operation and control philosophy has been worked out based on which the control display unit is being assembled. In addition a proposal of "Centralized LN_2/GN_2 transfer line" in New Laboratory building housing the LI-VISTA facility has been also been finalised to initiate procurement of this system.

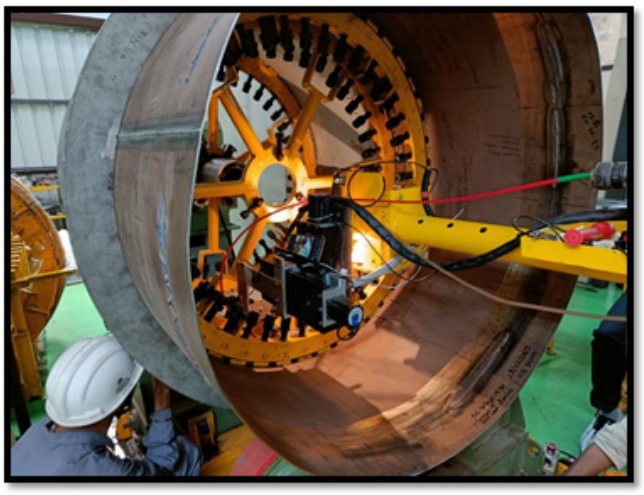

Figure B.2.2: Welding trials to qualify L-seam and C-Seam welding in Integrated Vacuum Vessel.

The LI_VISTA facility also hosts a baking furnace, SOLIDWORKS CAD facility, CDS/VCMS prototype test racks with associated electronics/computers/workstations.

Activities towards development of Control and Data System (CDS): As a part of prototyping activities for control and data system for LIGO India the basic CDS Test Rack has been developed at the institute. It includes one IO chassis loaded with data acquisition hardware and front-end computers as per LIGO USA configuration. A real-time LIGO CDS software on Debian-10 Linux using Cymac package on Front-End Computer has been configured, built and tested successfully on a CDS test rack for stand-alone operation. This has facilitated the users/developers working with LIGO Control basic tools using configured CDS Workstation for analysing engineering channels' data.

This year the LIGO USA archived data files have been accessed and interpreted using available in-

house software utilities in the CDS test facility. The facility is also being used as training.

A prototype Vacuum Control and Monitoring System (VCMS) Rack to operate and monitor outgassing measurement system at the institute has been developed along the lines of LIGO, USA slow controls configuration and tested during the year. The activities included procurement of 'Beckhoff' make automation hardware along with 'TwinCAT3' Software and development of a suitable hardware and software interface to monitor vacuum parameters and discrete control of various vacuum equipment. The EPICS interface with Twin CAT-IOC software required for slow controls using software packages from LIGO software repositories is also successfully configured and implemented for remote monitoring and control using EPICS configuration.

CHAPTER C & D

C. Academic Programme

D. Technical Services

C. ACADEMIC PROGRAMMES

C.1 DOCTORATE PROGRAMME

During this year, one (1) new student from Nuclear Engineering background has joined IPR as DDFS student and and is going through the course work. Overall there are total One hundred three (95) PhD students enrolled at present in HBNI including some IPR employees.

Ph.D. THESIS SUBMITTED (during April 2022 - March 2023)

Experimental Study of Low Power Microwave and Plasma Interactions
Joshi Hiral Bhaskarbhai
RK University, Rajkot, 2022

Study of Laser Interacting With Magnetized Plasma
Ayushi Vashistha
Homi Bhabha National Institute, 2022

Some Studies on Interaction of Laser with Overdense Plasma
Devshree Mandal
Homi Bhabha National Institute, 2022

Breaking of Large Amplitude Electrostatic Waves in Inhomogeneous Plasmas
Nidhi Rathee
Homi Bhabha National Institute, 2022

Molecular Dynamics Study of Convection Cells in 2D Yukawa Liquids
Pawandeep Kaur
Homi Bhabha National Institute, 2022

Radiation Reaction Effects on Laser Driven Acceleration of Charged Particles
Shivam Kumar Mishra
Homi Bhabha National Institute, 2022

Collective Dynamics of Active or Self-Propelled Particles
Soumen De Karmakar
Homi Bhabha National Institute, 2022

Study of Plasma Activation of Water and its applications in Antimicrobial and Agricultural activities
Vikas Rathore
Homi Bhabha National Institute, 2023

C.2 UG/PG ACADEMIC PROJECTS FOR EXTERNAL STUDENTS

Around 68 students, pursuing Under Graduate (UG)/ Post Graduate (PG) courses in science and engineering, were engaged to do various academic projects with the institite Faculties under their course curriculum in different fields of science and technology from various Colleges/Universities/ Institutes during April 2022 to March 2023.

D. Technical Services

D.1 Computer Division - IT Services and Infrastructure

Computer Division provides and manages the IT services and infrastructure at institutes main campus, FCIPT and CPP-IPR. The IT infrastructure is deployed and configured for High Availability (HA) with the facility for remote management for all IT services including Website, Webmail, Intranet services (E-office/INTRA portal services, IDRMS, E-cloud), critical Network services including video conferencing and broadcasting services. Computer Division has a state-of-the-art Data Centers (DC) to house all the critical IT infrastructure and HPC clusters which are monitored and maintained 24x7 at DC.The major IT activities carried out during the period from April 2022 to March 2023 are given below:

Data Center (DC):

• Data Center: Smooth day to day operations & management with achievement of 100% uptime. There was no unplanned downtime in this year.
• Implementation of new Containerized Data Center (CDC):

Figure D.1: Data center developed in the institute.

Computer Division has recently completed the installation of Containerized Data Center in February 2023 (Fig. D.1). This is a first of a kind installation in the Government setup. This new facility is built for the total IT load of 100kW in 8 racks with N+1 redundancy. Migration of few old servers and installation of new servers is in process. Apart from various server hosting this facility will also be used as a near DR facility.

• ETC (E-class & Training Center) at 2nd floor of Data Center is in process and 90% of the work is completed.

• New Data Center proposal and draft design submission is in process for upcoming building within the campus.

Email and Website Services:

• 100% uptime for Email and Website services.
• Operational Management of BRNS portal.
• Addition of new pages in the website on R&D work, HPC newsletter etc.

Intranet Web Services:

• In-house development of E-office/INTRA Portal Services: Migration of utilities/modules, for various official requisition and online administrative approvals, from E-office to INTRA portal.
• On-premises private cloud-based file-sync data service named ECLOUD/MEGH was made available to Users for sharing big-size files and working collaboratively within the Institute.
• IP Address Management (IPAM) System portal for registering devices (mobile, laptop, desktop, tablet, etc.) is functional.

Network and Video Conference Services:

• GMEET implementation: Configuration and deployment of new VC service (GMEET) to add new features like recording, streaming, etc. in line with the other available commercial software.
• Institute Campus Wi-Fi implementation is in final stage
• Using virtualization technology for running IT services like Webmail, Intranet web services, Proxy, VPN, etc.
• Deployment of Centralized Authentication through Active Directory control for availing various IT services like internet/VPN/Intra/Gmeet/Ecloud authentication.
• CPP-IPR IT Infrastructure: New Wi-Fi 6 installation is completed with Guest Portal.

Centralized Procurement of new systems and Disposal of end-of-life systems:

• Procurement and installation of desktop computers in batches for employees.
• Procurement of Centralized storage system.
• Awarded HPC ANTYA Comprehensive Maintenance Contract.
• Procurement process of High Performance Computing System with GPUs is towards completion.
• Removal of old desktop/laptop PCs under the e-waste category.
• Large TV Display units are procured and installed at Committee Room-1, Committee Room-2, Guest House Meeting Room, and RS Class Room.
• Video Wall (3x2 Matrix) procurement and installation for Board Room is completed.

Centralised Storage Infrastructure and File Share and Sync Service:

• Computer Division (CD) has procured a centralised storage of capacity 1700 TB and deployed an Enterprise File Share and Sync (EFSS) software providing the functionally like Dropbox, Google-

Drive, OneDrive etc.
• This solution is to manage storage of unstructured data by providing storage as services to various departments, projects and individual to store official data.
• The newly procured storage solution has been deployed in the institute's Data Centre (DC). The centralised storage has been made available on the intranet. It is successfully integrated with provision for infrastructure to back up the IT workload and experimental data of the institute.

D.2 SIRC (Library) Services

Scientific Information Resource Centre (SIRC) is providing specialized Information Resources and Publication Management services using contemporary tools to the scientific community involved in the Research and Development activities of Plasma Physics and Fusion Science and Technology.

During the year 2022-23 a total budget of Rs. 40523988.00 was utilized and added the following to its collection:
Books – 125 and 12 eBooks from American Mathematical Society (AMS) collection. Reprints – 182; Pamphlets – 10. The library had access to 340 eBooks in the areas of Physics for the year 2022-23 through an Evidence Based Acquisition (EBA) access model.

The library subscribed to 101 periodicals and added 1 new online journal title as well as a journal archive to the e-collection and continued to subscribe to major databases such as SCOPUS, APS-ALL, Online Archives of core journals, and it has access to SCIENCEDIRECT as part of the DAE Consortium, NUCNET News service, and also added electronic backfiles of one journal.

In the fast changing information landscape, keeping the scientific community updated with the latest developments in the areas of research is very crucial. Library installed a Digital Display Board to provide interactive and up-to-date Current Awareness Services. Library is also delivering email-based FYI-Fusion News Alerts services to IPR, CPP and ITER-India users. Total 145 News items were sent/displayed and archived as an Alerting Service. Scientific News in Hindi language are also displayed on the library noticeboard, a total of 9 news items were displayed during the year.

Library continued to collaborate with DAE units and other National and International libraries to provide Inter-Library Loan (ILL) services. 95.12% of the requests made by staff members were satisfied through ILL service. IPR Library provided documents to other institutes against their queries and 100% of the total need were satisfied.

In 2022-23, Library provided 23192 photocopies/ prints and 8969 scanned copies to the users.

Publication Management Services were carried out efficiently and SIRC continued to subscribe to anti-plagiarism software tool for checking similarity index of the publications. A total of 719 manuscripts (Abstract/Papers) and 05 Patent information were broadcasted to the Staff through the Pre-Publication Broadcasting System and Pre-Patent Broadcasting System respectively on the Intranet portal. A new feature for Conference and Awards information submission has been developed and implemented on the INTRA portal.

SIRC published the following during the year 2022-23: Internal Technical Reports – 60; Internal Research Reports – 109; IPR Publications in Journals – 162; IPR Publications in Conference Proceedings – 23; Book Chapters – 5.

Hands-on Training was imparted to the four library trainees recruited for a period of one year. Library Internship was provided to three library science students from Gujarat University, Ahmedabad. Orientation was given to newly joined members and Research Scholars. Library is actively participating and contributing to other Institutional activities, such as Swacchata Abhiyan, Safety Week, National Science Day, etc. Library is also actively involved in OLIC and promoting usage of Hindi language.

D.3 Mechanical Engineering Services Division (MESD)

MES division has four sections namely Engineering Design & Analysis Section (EDAS), Inspection & Quality Section (IQS), Drafting Section and Workshop Section. The activities undertaken by the division is conforming to full product cycle which includes concept to commissioning. The major tasks are design and analysis of the product/system, preparation of the engineering drawings, fabrication/manufacturing and inspection, testing and commissioning. The division is also supporting the inspection of incoming stock items at Store. The division comprises of team of Mechanical Engineers, draftsman and technicians. MESD division has provided the services to different divisions such as SST-1, ADITYA, Magnet, Cryogenic, Neutronics, Remote handling, NBI, Fusion Blanket, Cryopump, Fundamental Physics etc. MESD also provided the extensive services to FCIPT also.

The EDAS of MESD has been actively executing various tasks related to design, analysis, fabrication, inspection and testing. Since its inception in April 2017, section has satisfactorily completed and submitted reports for more than 100 tasks for different divisions. The design is carried out using ASME, WRC codes, vacuum protocol etc. The FEM analysis is performed to ensure the structural integrity of the system/product. Analysis related to structural, thermal and coupled modes is carried out routinely using ANSYS.

The IQS of MESD has been actively executing various tasks related to Welding Procedure Specification, Manufacturing and Inspection Plan, Material testing, Quality Assurance, Quality Control, Different kinds of Non-Destructing testing etc. The activity related to assembly, disassembly, interference checking, new components assembly etc. of the different components for SST-1 are also supported by this section.

The Drafting section of MESD is equipped with 6 licences of CATIA-V5 R13 installed on work stations for 3D modelling and 2D drawing preparation, HP inkjet printer T2300 plotter. Section has been supporting the users for designing and preparation of engineering drawings for various systems of IPR. During the year, section has executed more than 400 job cards for 3D modelling and 2D engineering drawing preparations. Section is also supporting the poster printing for different conferences and presentations.

The Workshop section of MESD is equipped with modern versatile machineries including machining and fabrication (shearing, rolling, TIG welding etc.) facilities catering to the needs of the institute, FCIPT, ITER-India and CPP for the fabrication of a system/product required by users. Workshop has a 3-axis abrasive water-jet machining facility useful for machining the intricate shapes of different materials at room temperature. It has also CNC and VMC machining centre. Workshop is also manufacturing vacuum components which are used as stores stock items. During the year, workshop has executed more than 1400 job cards (including 200 job cards of abrasive water jet machining) and

fabricated systems/product of different materials (Stainless steel, Aluminium, Copper, Brass, Ceramics, Teflon, Hylum, PEEK etc.) weighing more than 8000 kgs.

D.4 Air Handling Unit and Air Conditioning Services

Figure D.2: Direct expansion air handling unit and air conditioning system is for existing class 10000 clean room for SRP Lab at FCIPT campus.

This Direct Expansion (DX) Air Handling Unit (AHU) Air Conditioning system is for existing clean room, which is designed, constructed and commissioned for SRP Lab at FCIPT campus. The clean room is equipped with very sensitive, critical and costlier instruments which required stringent controlled environment. The clean room is of Class 100000 having dimensions of 5.2(L) x 3.7(W) x 2.3(H) mtr (Fig. D.2).

The new DX AHU air conditioning system consists of two condensing units (1Working+1Standy). The accessories includes supply and return dampers, fire damper, ducted heater, GI ducting, electric control panel, power and control cables etc.

D.5 Data Acquisition and Control System

Centralised Energy Monitoring System for LT Electrical Distribution: The collaborative efforts of Data Acquisition and Control Division (DACD) and EPDS divisions have resulted in the creation of a state-of-the-art Centralized Energy Monitoring System (EMS) (Fig. D.3, D.4 and D.5) for LT electrical distribution. This advanced EMS system offers remote monitoring capabilities for over 200 multi-function panel meters, installed across various buildings, ensuring comprehensive oversight of electrical parameters.

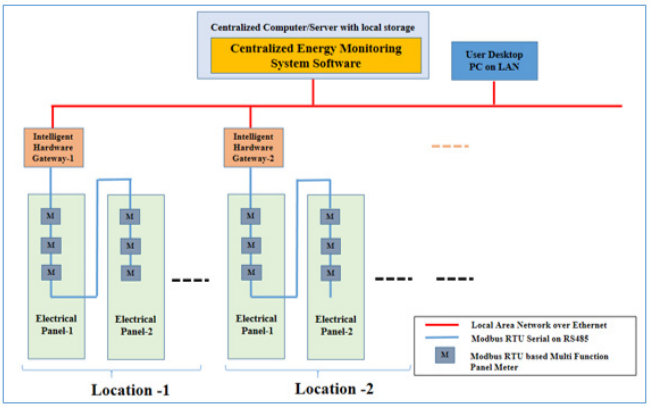

Figure D.3: Centralized Energy Monitoring System (EMS) Architecture

To facilitate seamless monitoring, all panel meters have been intelligently interfaced with a Local Area Network (LAN) through the utilization of intelligent hardware gateways. This integration enables continuous operation of the system, which diligently generates automated reports on a daily

basis. With the centralized EMS in place, we can now effortlessly monitor and analyze critical electrical data and can optimize energy utilization.

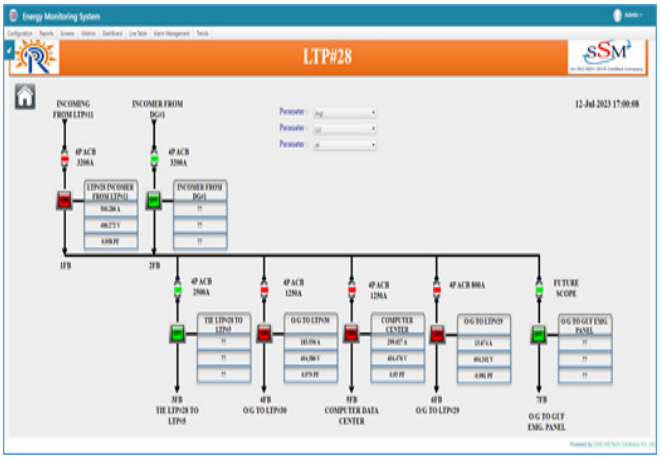

Figure D.4: Monitoring of one of the panels (EMS).

Figure D.5: Datacentre 24 hour Average Current (EMS).

<u>*Instrumentation and Control of Inverse Mirror Plasma Experimental Device (IMPED) Experiments:*</u> The DACD in collaboration with Funda mental Plasma Experimental Division (FPED) division has developed a comprehensive control system to facilitate motion control for multiple motorized plasma diagnostic probe drive systems within the IMPED device (Fig. D.6). The IMPED device is equipped with twelve motorized probe drive systems, which play a crucial role in active plasma diagnostics by conducting various positional scans. Our objective was to automate these positional scans by integrating all the probe drive systems into a unified system that allows coordinated and simultaneous control through remote operation (Fig. D.7).

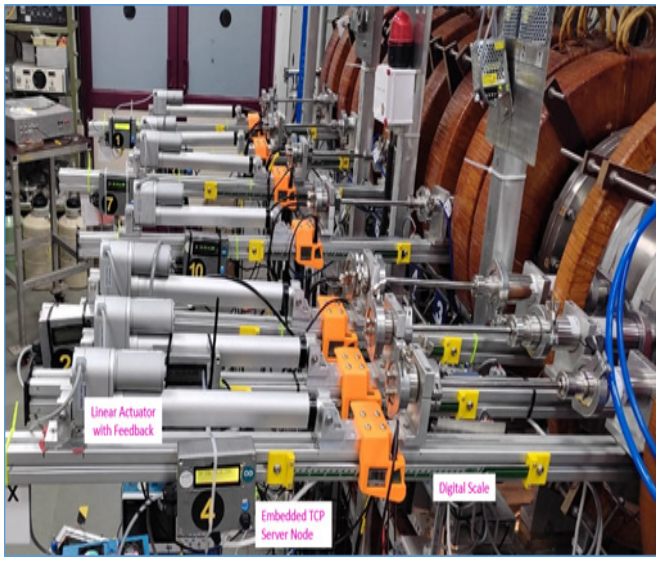

Figure D.6: IMPED Experiment Setup.

The key advancements of the architecture lie in two areas. First relates to the incorporation of Ethernet-based Standard Commands for Programmable Instruments (SCPI) using an embedded TCP server node. This integration enhances the system's versatility and enables seamless communication with the probe drive systems. Second is the adoption of a data-driven position control philosophy, which empowers operation of multiple probe drive systems simultaneously in a coordinated manner. Additionally, a data acquisition system has been integrated, which significantly enhances the efficiency and ac-

curacy of interpreting the acquired measurements during IMPED experiments. In summary, such an automation of positional scans and enabling of remote operation of diagnostics on IMPED, allows for improved measurements and the plasma precise interpretation of acquired data.

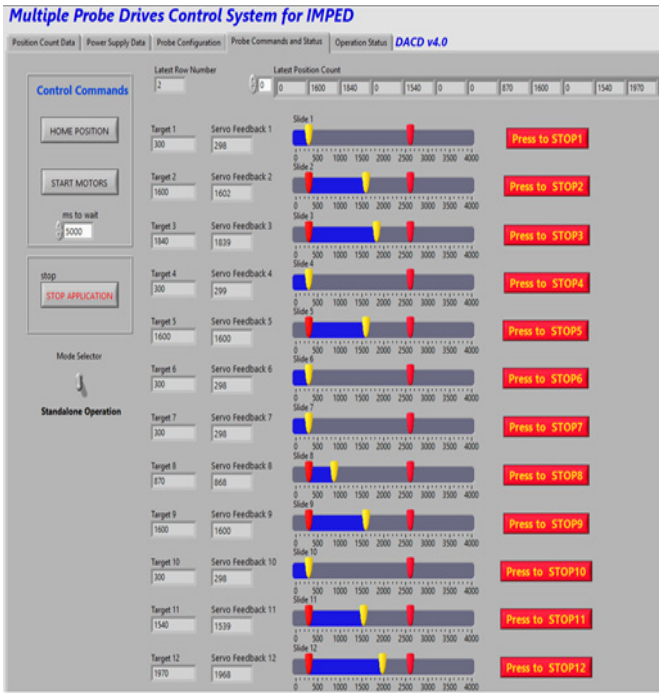

Figure D.7: Multiple Probe Drives Control System User Interface.

In-house Design and Development of Data Acquisition Module: The division has undertaken an exciting venture in the realm of data acquisition by embarking on the in-house design and development of a cutting-edge data acquisition module. Harnessing the unparalleled benefits of the PCIe bus, (Fig. D.8) including low latency, high bandwidth, and cost efficiency, we are spearheading the creation of a state-of-the-art FPGA-based multifunction PCIe data acquisition card.This module has an array of features, such as 16 channels of bipolar 16-bit analog input, 8 channels of 16-bit analog output and as 32 channels of isolated digital input. The hardware manufacturing phase has been completed, and present efforts are concentrated on the development of firmware and Linux drivers. Once successfully implemented, it will cater to a diverse range of requirements across numerous projects.

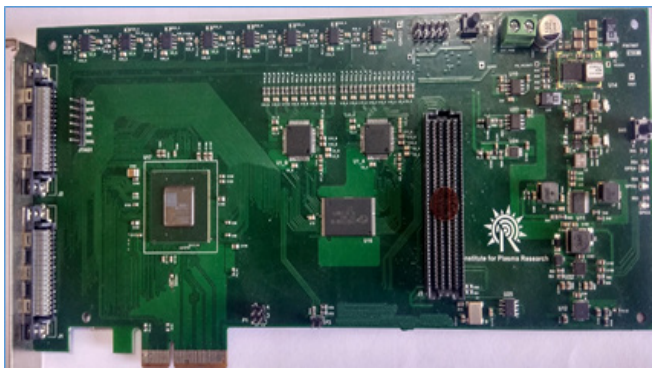

Figure D.8: Manufactured PCIe card.

Confidential and Efficient OMR - Based Results Evaluation Software for Exam management: To ensure the confidentiality of exams conducted by the institute for various job positions, the division has implemented a secure OMR-based result evaluation software. This software facilitates all the necessary activities related to result evaluation while maintaining the utmost confidentiality. These activities include customizing the software to create templates for the required number of questions, assigning appropriate weightages to correct and wrong answers, handling ambiguous questions, and generating stream-wise results and merit lists. By utilizing this software, the division has achieved accurate, efficient, and cost-effective result evaluation. The customization of templates ensures compatibility with specific exams, allowing for seamless processing of answer sheets. Assigning weightages to answers enables fair evaluation, while effectively handling ambiguous questions

ensures consistent and unbiased results. Moreover, the software's capabilities extend to generating stream-wise results and merit lists, which aids in the selection process for various job positions. This feature assists in identifying top performers and facilitates decision-making regarding candidate qualifications.

D.6 Civil Infrastructure

After placing work order in second quarter (Q2-2022) for construction of new shed building (~460 Sqm) at FCIPT Campus in Gandhinagar, work is progressing well and expected to be completed soon.

Institute has entrusted Directorate of Construction Services and Estate Management (DCSEM), Mumbai for the Design and Construction Management in development of additional infrastructure in institute's campus. New infrastructure development in the institute's campus include construction of sewerage treatment plant (STP), New Canteen Building, shed Building for Stores and Reception Building at 2nd gate in the institute's campus. DCSEM has made significant progress in this tasks, tender process for STP is completed and successful bidder is selected to place work order. Construction design details have been worked out for reception building and Shed Building for Stores and plan is to float tender for these buildings. Under pre-construction activity, soil testing is performed for ITER-India building within the institute campus, and process for hiring consultant to co-ordinate with allied agencies to obtain statutory permissions pertaining to construction activities is in progress.

In other minor works, Institute has completed construction of a platform with fencing for Electro-Magnetic Laboratory (EML) and a new borewell, while works related to construction of additional toilet block at institute's guest house and increase in height of compound wall putting concertina coil fencing along entire campus periphery are expected to be completed soon.

At FCIPT campus, construction of watch towers, concertina coil fencing and internal pathway along the entire boundary wall is nearing completion. Renovation and upgradation works in the institute's campus, several renovation works at FCIPT campuses in Gandhinagar have been completed. Major among them include, in FCIPT campus – renovation of canteen building, In institute's campus – Resurfacing of internal roads, renovation including painting of canteen, workshop and security watch towers, first floor offices in old building, renovation of building areas, flooring, roof leak proofing and internal painting of scientific laboratories, water chiller plant etc. Other miscellaneous works which are in progress include renovation of washrooms, workshop building.

D.7 Radio Frequency Laboratory

The Radio Frequency (RF) lab helped various groups in developing RF related systems/sub-systems/components etc. which include, (i) 3 1/8" coaxial two way switch; (ii) 1 5/8" liquid stub tuner; (iii) producing high density (of the order of 10^{18} / m^3) RF plasma in Multi-cusp device; (iv) Developing 6 1/8" very high susceptance stub tuner; (v) Developing 3 1/8" and 6 1/8" box type phase shifter; (vi) producing successfully the RF plasma in APPLE device with 2 kW of RF source; (vii) Developed 1 5/8" gas stub tuner; (viii) Developed N-type to 1 5/8" and N-type to 3 1/8" adapters.

D.8 Electronics and Instrumentation Division

Electronics & Instrumentation Division (EID) has been providing its services to ADITYA-U and

SST-1 Tokamak, different subsystems of these Tokamaks, basic experimental machines and other experiments of the Institute. For the year 2022-23, various electronics have been developed, installed and commissioned. EID has installed around 100 nos. of electronics which majorly include signal conditioning electronics for plasma diagnostics and high voltage electronics of Spectroscopy, Operation electronics like analog integrators for Tokamak, Langmuir Probe and Timing system for Basic Experiments. The design has been up-graded for low power consumption and higher channel density. With the use of miniature components, channel density has been increased four times compared to the older designs for similar requirement. EID has commissioned PLC based automation for 15 KV high voltage capacitor based charging power supply for pellet injector system in ADITYA-U. EID has indigenously developed 32 channel SBC based data acquisition board with a sampling rate of 200 kSamples/sec/channel. One board is configured and commissioned for the measurement of magnetic field of SST-1 null using hall sensors. The System-on-Chip based data acquisition system which integrates isolated electronics on-board is commissioned for EM Diagnostics in ADITYA-U.

CHAPTER E & F

E. Publications and Presentations

F. Other Activities

E. PUBLICATIONS AND PRESENTATIONS

E.1 Articles Publications

E.1.1 Journal Articles

Morphology Induced Large Magnetic Anisotropy in Obliquely Grown Nanostructured Thin Film on Nanopatterned Substrate
ANUP KUMAR BERA, ARUN SINGH DEV, MANIK KUILA, MUKESH RAJAN, PALLAVI PANDIT, MATTHIAS SCHWARTZKOPF, STEPHAN V. ROTH, VARIMALLA R. REDDY, and DILEEP KUMAR
Applied Surface Science, 581, 152377, April 2022

Cross-Section of (n, 2n) Reaction for Niobium and Strontium Isotopes between 13.97 to 20.02 MeV Neutron Energies
MAYUR MEHTA, N. L. SINGH, RATANKUMAR SINGH, RAKESH CHAUHAN, RAJNIKANT MAKWANA, S. V. SURYANARAYANA, H. NAIK, P. V. SUBHASH, S. MUKHERJEE, JAN VARMUZA, KAREL KATOVSKY
Applied Radiation and Isotopes, 182, 110142, April 2022

Overview of Recent Experimental Results from the ADITYA-U Tokamak
R.L. TANNA, TANMAY MACWAN, J. GHOSH, K.A. JADEJA, ROHIT KUMAR, S. AICH, K.M. PATEL, HARSHITA RAJ, KAUSHLENDER SINGH, SUMAN DOLUI, ANKIT KUMAR, B.K. SHUKLA, P.K. CHATTOPADHYAY, M.N. MAKWANA, K.S. SHAH, S. GUPTA, V. BALAKRISHNAN, C.N. GUPTA, V.K. PANCHAL, PRAVEENLAL EDAPPALA, B. ARAMBHADIYA, MINSHA SHAH, PRAMILA GAUTAM, V. RAULJI, PRAVEENA SHUKLA, R. RAJPAL, U.C. NAGORA, KIRAN PATEL, NANDINI YADAVA, S. PATEL, N. RAMAIYA, M.B. CHOWDHURI, R. MANCHANDA, R. DEY, G. SHUKLA, K. SHAH, VARSHA S, J. RAVAL, S. PUROHIT, K. TAHILIANI, D. KUMAWAT, S.K. JHA, N. BISAI, P.K. ATREY, S.K. PATHAK, M.K. GUPTA, M.V. GOPALKRISHANA, B.R. DOSHI, DEEPTI SHARMA, R. SRINIVASAN, D. RAJU, CHETNA CHAUHAN, Y.C. SAXENA, ABHIJIT SEN, R. PAL and S. CHATURVEDI
Nuclear Fusion, 62, 042017, April 2022

Spatially Selective Nanoplasmonic Response in Ag Embedded GLAD TiO2 Nanocomposite Thin Films
RAJNARAYAN DE, S. MAIDUL HAQUE, M. K. SIKDAR, P. K. SAHOO, S. KESARI, CH KISHAN SINGH, S. STINE, M. RANJAN, R. RAO, K. DIVAKAR RAO
Optical Materials, 126, 112122, April 2022

Estimation of Vacuum Vessel Time-Constant in ADITYA-U Tokamak
ROHIT KUMAR, S. K. JHA, SUMAN AICH, TANMAY MACWAN, DEVILAL KUMAWAT, R. L. TANNA, J. GHOSH, KAUSHAL PATEL, KUMARPAL JADEJA
Fusion Engineering and Design, 177, 113055, April 2022

Operating a Full Tungsten Actively Cooled Tokamak: Overview of WEST First Phase of Operation
J. BUCALOSSI, R. DANIEL et. al
Nuclear Fusion, 62, 042007, April 2022

Laser Intensity Profile Based Terahertz Field Enhancement from a Mixture of Nano-Particles Embedded in a Gas
P. VARSHNEY, A. P. SINGH, M. KUNDU, K. GOPAL
Optical and Quantum Electronics, 54, 222,

April 2022

Physics Studies of ADITYA & ADITYA-U Tokamak Plasmas Using Spectroscopic Diagnostics
R. MANCHANDA, M. B. CHOWDHURI, J. GHOSH, N. RAMAIYA, N. YADAVA , S. PATEL, G. SHUKLA, K. SHAH, R. DEY, K. A. JADEJA, K. M. PATEL, R. L. TANNA S. K. PATHAK, B. V. NAIR, C. N. GUPTA and ADITYA-U TEAM
Nuclear Fusion, 62, 042014, April 2022

Study of Solid Hydrogen Pellet Speed in a Gas Gun–Type Injector
J. MISHRA, R. GANGRADEY, P. NAYAK, S. MUKHERJEE
Fusion Science and Technology, 78, 211, April 2022

Numerical Simulation of a Bi-Directional Plasma Thruster for Space Debris Removal
VINOD SAINI and RAJARAMAN GANESH
Journal of Plasma Physics, 88, 905880203, April 2022

On the Effects of H2 and Ar on Dual Layer Formed by Plasma Nitrocarburizing on Austenitic Stainless Steels
JEETA SAH, ALPHONSA JOSEPH, GHANSHYAM JHALA, SUBROTO MUKHERJEE
Journal of Materials Engineering and Performance, 31, 2664, April 2022

Data Driven Discovery of a Model Equation for Anode-Glow Oscillations in a Low Pressure Plasma Discharge
BHUMIKA THAKUR, ABHIJIT SEN and NEERAJ CHAUBEY
Physics of Plasmas, 29, 042112, April 2022

Progress in ITER ECE Diagnostic Design and Integration
Y. LIU, V.S. UDINTSEV, S. DANANI, G. PARAISO, G. TAYLOR, M.E. AUSTIN, A. BASILE, J.H. BENO, B. BUNKOWSKI, R. FEDER, T. GIACOMIN, J. GUIRAO, S. HOUSHMANDYAR, H. HUANG, A.E. HUBBARD, S. HUGHES, S. JHA, A. KHODAK, R. KUMAR, S. KUMAR, V. KUMAR, P. MAQUET, C. NAZARE, H. NEILSON, A. OUROUA, S. PAK, H.K.B. PANDYA, C. PENNEY, P.E. PHILLIPS, S. PISH, J. POISSY, W.L. ROWAN, A. SAXENA, M. SCHNEIDER, S.M. STRANK, S. THOMAS, G. VAYAKIS, F.L. WAELBROECK, M.J. WALSH and L. WORTH
Journal of Instrumentation, 17, C04019, April 2022

Phase Locked Loop System with SIW-Based Bandpass Filter for D-Band Microwave Interferometer
ALPESH VALA, AMIT PATEL, BHARGAV PATEL, ABHISHEK SINHA,UMESH NAGORA, SURYA PATHAK JITENDRA CHAUDHARI and HIREN MEWADA
IETE Journal of Research, 68, 255, April 2022

DIII-D Research Advancing the Physics Basis for Optimizing the Tokamak Approach to Fusion Energy
M. E. FENSTERMACHER, A. CHATTOPADHYAY, R. MANCHANDA, et. al.
Nuclear Fusion, 62, 42024, April 2022

Dust-Ion Acoustic Solitary Waves in a Collisionless Magnetized Five Components Plasma
PALTU HALDER, ANUP BANDYOPADHYAY, SANDIP DALUI and SANKIRTAN SARDAR
Journal of Physical Sciences: Zeitschrift fur Naturforschung A, 77, 659, April 2022

Effect of Directional Nature of Antenna and

Magnetic Field Strength on Optimal Power Absorption in a Helicon Discharge
N. SHARMA, M. CHAKRABORTY, S. BORTHAKUR, N. K. NEOG and M. BANDYOPADHYAY
Plasma Physics Reports, 48, 395, April 2022

Numerical Evaluation for Spacer Vane Effects on Flow and Heat Transfer of Water at Supercritical Pressure in Annular Channel
SATISH KUMAR DHURANDHAR, S. L. SINHA and SHASHI KANT VERMA
Nuclear Science and Engineering, 196, 600, May 2022

Design and Development of Dielectric Barrier Discharge Setup to Form Plasma-Activated Water and Optimization of Process Parameters
VIKAS RATHORE, CHIRAYU PATIL, ADAM SANGHARIYAT and SUDHIR KUMAR NEMA
European Physical Journal D, 76, 77, May 2022

Mode Conversion and Laser Energy Absorption by Plasma under an Inhomogeneous External Magnetic Field
SRIMANTA MAITY, LAXMAN PRASAD GOSWAMI, AYUSHI VASHISTHA,
DEVSHREE MANDAL and AMITA DAS
Physical Review E, 105, 055209, May 2022

Equilibrium Magnetic Field Requirements during Plasma Initiation and Current Ramp-Up Phase in ADITYA/ADITYA-U Tokamak Discharges
RAKESH L. TANNA, JOYDEEP GHOSH, CHETNARAYAN GUPTA, BALAKRISHNAN V. NAIR, SHIVAM GUPTA, MOTI N. MAKWANA, KUNAL SHAH, SUPRIYA NAIR, ROHIT KUMAR, SUMAN AICH, KUMARPALSINH A. JADEJA, KAUSHAL M. PATEL, TANMAY MACWAN, KAUSHLENDER SINGH, SUMAN DOLUI, ANKIT KUMAR,
CHETNA CHAUHAN, RAJENDRA P. BHATTACHARYAY, PRABAL K. CHATTOPADHYAY, MALAY BIKAS CHOWDHURI, RANJANA MANCHANDA, YOGESH CHANDRA SAXENA and ADITYA-U TEAM
Plasma and Fusion Research, 17, 2402046, May 2022

Systematic Study of the (n, 2n) Reaction Cross Section for 121Sb and 123Sb Isotopes
RATANKUMAR SINGH, N.L. SINGH, RAKESH CHAUHAN, MAYUR MEHTA,SARASWATULA SURYANARAYAN, RAJNIKANT MAKWANA, B K NAYAK, H. NAIK, TARAK NATH NAG and KAREL KATOVSKY
Chinese Physics C, 46, 054002, May 2022

Current Drive Experiments in SST1 Tokamak with Lower Hybrid Waves
P. K. SHARMA, D. RAJU, S. K. PATHAK, R. SRINIVASAN, K. K. AMBULKAR, P. R. PARMAR, C.G. VIRANI, J. KUMAR, S. SHARMA, C. SINGH, A. L. THAKUR, V. L. TANNA, U. PRASAD, Z. KHAN, D. C. RAVAL, C. N. GUPTA, B. KRISHNAN, S. NAIR, D. K. SHARMA, B. DOSHI, M. VASANI, K. MAHAJAN, R. RAJPAL, R. MANCHANDA, K. ASUDANI, M. K. GUPTA, M. B. CHOWDHURI, R. L. TANNA, SST-1 and DIAGNOSTIC TEAMS
Nuclear Fusion, 62, 056020, May 2022

Forster Resonance Energy Transfer between Fluorescent Organic Semiconductors: Poly (9, 9-Dioctylfluorene-Alt-Benzothiadiazole) and 6, 13-Bis (Triisopropylsilylethynyl) Pentacene
HEMLATA BISHT, ABHINAV PRATAP SINGH, HEM CHANDRA JOSHI, SATYABRATA JIT, and HIRDYESH MISHRA
The Journal of Physical Chemistry B, 126, 3931, May 2022

A Study on the Influence of External Magnetic Field on Nitrogen RF Discharge using Langmuir Probe and OES Methods
ATRI MUKHERJEE, NARAYAN SHARMA, M CHAKRABORTY and PABITRA K SAHA
Physica Scripta, 97, 055601, May 2022

Design and Analysis of a Plasma Chamber for Thermal Processing Applications
DEEPAK SHARMA, ATIK MISTRY, VADIVEL MURUGAN PALANICHAMY, ADAM SANGHARIYAT, HARDIK MISTRY, PARITOSH CHAUDHURI,SHASHANK CHATURVEDI and SUDHIR K. NEMA
Plasma and Fusion Research, 17, 2406051, May 2022

Emergence of Directed Motion in a 2D System of Yukawa Particles on 1D Ratchet
ANSHIKA CHUGH, RAJARAMAN GANESH
Physica A: Statistical Mechanics and its Applications, 593, 126913, May 2022

Oxygen Plasma for Prevention of Biofilm Formation on Silicone Catheter Surfaces: Influence of Plasma Exposure Time
PURVI DAVE, C. BALASUBRAMANIAN, SUKRITI HANS, CHIRAYU PATIL and S. K. NEMA
Plasma Chemistry and Plasma Processing, 42, 815, May 2022

Comparative Study of LIBS Signal for Single and Colliding Plasma Plumes in a Variable Magnetic Field
PRAVIN KUMAR TIWARI, NARAYAN BEHERA, R.K. SINGH, H.C. JOSHI
Spectrochimica Acta Part B: Atomic Spectroscopy, 191, 106411, May 2022

On the Delayed Emission from a Laser-Produced Aluminum Plasma under an Argon Environment
GARIMA ARORA, JINTO THOMAS, and H. C. JOSHI
Journal of Analytical Atomic Spectrometry, 37, 1119, May 2022

Wave Studies using Triple Langmuir Probe in Transient Plasma
S. BORTHAKUR, N. K. NEOG and T. K. BORTHAKUR
Plasma Physics Reports, 48, 560, May 2022

Neutronic Analysis of Indian Helium-Cooled Solid Breeder Tritium Breeding Module for Testing in ITER
H L SWAMI, DEEPAK SHARMA, C DANANI, P CHAUDHARI, R SRINIVASAN and RAJESH KUMAR
Plasma Science and Technology, 24, 065601, June 2022

Real-Time Density Feedback Control in ADITYA-U Tokamak
KIRAN PATEL, UMESH NAGORA, H.C. JOSHI, SURYA PATHAK, K.A. JADEJA, KAUSHAL PATEL, CHETAN VIRANI, ANKIT PATEL, R. L. TANNA, ROHIT KUMAR, SUMAN AICH and JOYDEEP GHOSH
Journal of Instrumentation, 17, 06004, June 2022

Long Time Fate of Two-Dimensional Incompressible High Reynolds Number Navier-Stokes Turbulence: A Quantitative Comparison between Theory and Simulation
SHISHIR BISWAS and RAJARAMAN GANESH
Physics of Fluids, 34, 065101, June 2022

Design and Development of a Liquid Nitrogen Cooled Test Cryopump for Application in Steady-State Superconducting Tokamak-1

RANJANA GANGRADEY, SAMIRAN S. MUKHERJEE, VISHAL GUPTA, PARESH PANCHAL, PRATIK NAYAK, JYOTI S. MISHRA, AVIJIT DEWASI, SHASHI KANT VERMA
Vacuum, 200, 110986, June 2022

Equilibrium Properties of Inhomogeneous Partially-Magnetized Plasma Containing Negative Ions
PAWANDEEP SINGH, SWATI and SHANTANU KUMAR KARKARI
Journal of Physics D: Applied Physics, 55, 235201, June 2022

IDP Detection in Earth Environment: Prediction of Plasma Capture Efficiency and Detector Response to High-Energy Particles
J.P. PABARI, S. NAMBIAR, R.K. SINGH, ANIL BHARDWAJ, K.A. LAD, K. ACHARYYA, J.M. JAKHARIYA, S. JITARWAL, RASHMI, V. SHEEL
Planetary and Space Science, 215, 105452, June 2022

Laser Ablation Fabrication of a p-NiO/n-Si Heterojunction for Broadband and Self-Powered UV-Visible-NIR Photodetection
SAVITA CHAOUDHARY, AVIJIT DEWASI, RAM PRAKASH S, VIPUL RASTOGI, RUI N PEREIRA, ALESSANDRO SINOPOLI, BRAHIM AISSA and ANIRBAN MITRA
Nanotechnology, 33, 255202, June 2022

Understanding the Surface Wave Characteristics Using 2D Particle-In-Cell Simulation and Deep Neural Network
RINKU MISHRA, S. ADHIKARI, RUPAK MUKHERJEE and B. J. SAIKIA
Physics of Plasmas, 29, 062104, June 2022

Investigating the Effects of Electron Bounce-Cyclotron Resonance on Plasma Dynamics in Capacitive Discharges Operated in the Presence of a Weak Transverse Magnetic Field
SARVESHWAR SHARMA, SANKET PATIL, SUDIP SENGUPTA, ABHIJIT SEN,
ALEXANDER KHRABROV and IGOR KAGANOVICH
Physics of Plasmas, 29, 063501, June 2022

Evaluation of Three Methods of Static Contact Angle Measurements for TiO2 Nanofluid Droplets during Evaporation
SYLWIA WCISLIK and SAYANTAN MUKHERJEE
Physics of Fluids, 34, 062006, June 2022

Activation of Water in the Downstream of Low-Pressure Ammonia Plasma Discharge
VIKAS RATHORE, VYOM DESAI, NIRAV I. JAMNAPARA and SUDHIR KUMAR NEMA
Plasma Research Express, 4, 025008, June 2022

Numerical Study on the Effect of Plasma Density on Runaway Electron Suppression in the ADITYA-U Tokamak
ANSH PATEL, SANTOSH P. PANDYA, TANMAY M. MACWAN, UMESHKUMAR C. NAGORA, JAYESH V. RAVAL, K. A. JADEJA, SAMEER KUMAR JHA, ROHIT KUMAR, SUMAN AICH, SUMAN DOLUI, KAUSHLENDER SINGH, K. M. PATEL, KUMUDNI TAHILIANI, SURYA KUMAR PATHAK, RAKESH L. TANNA, JOYDEEP GHOSH, MANOJ KUMAR, and ADITYA-U TEAM
IEEE Transactions on Plasma Science, 50, 1445, June 2022

On Suitable Experiments for Demonstrating the Feasibility of the Beam-Driven Plasma Neutraliser for Neutral Beam Injectors for Fusion Reactors

G. STARNELLA, C. HOPF and P. N. MAYA
Nuclear Fusion, 62, 066038, June 2022

Estimation of Production Cross-Sections, Transmutation and Gas Generation from Radionuclides (A ~50-60) in Fusion Environment
JYOTI PANDEY, BHAWNA PANDEY, P. V. SUBHASH, PRITI KANTH, MAYANK RAJPUT, S. VALA, RAJNIKANT MAKWANA, S. V. SURYANARAYANA, H. M. AGRAWAL
Applied Radiation and Isotopes, 184, 110163, June 2022

Development of Resistive-Ink Based Planar and Conformal Metasurfaces for RCS Reduction
PRIYANKA TIWARI, SURYA KUMAR PATHAK, and VARSHA SIJU
IEEE Access, 10, 61472, June 2022

Validation of 3-D Non-Isothermal CFD Simulation with Experimental Results for Single-Screw Hydrogen Extruder
VISHAL GUPTA, RANJANA GANGRADEY, SAMIRAN S. MUKHERJEE, SHASHIKANT VERMA, AVIJIT DEWASI, J. MISHRA, PARESH PANCHAL, PRATIK A. NAYAK
Cryogenics, 124, 103471, June 2022

Sensing a Change in Size of a Circular Tokamak Plasma using a Single Magnetic Probe: A Theoretical Approach
SUMAN AICH, JAHAAN THAKKAR, JOYDEEP GHOSH
Plasma and Fusion Research, 17, 2403055, June 2022

Conceptual Design and Analysis of Prototype Center Stack for Spherical Tokamak Based Technologies Development
ADITYA KUMAR VERMA, RANJITH KUMAR SANTHARAM, PRASADA RAO PEDADA, SHIJU SAM, YELLAMRAJU S.S. SRINIVAS, RAJENDRA KUMAR ELLAPPAN
Plasma and Fusion Research, 17, 2405074, June 2022

Design, Simulation, Fabrication and Testing of LIM for EML
P PRASADA RAO, ARVIND KUMAR, ANANYA KUNDU, ANKUR JAISWAL, VILAS CHAUDHARI, SIDIBOMMA RAMBABU, Y.S.S. SRINIVAS, and E. RAJENDRAKUMAR
Sadhana - Academy Proceedings in Engineering Sciences, 47, 77, June 2022

The Role of Different Plasma Forming Gases on Chemical Species Formed in Plasma Activated Water (PAW) and their Effect on its Properties
VIKAS RATHORE and SUDHIR KUMAR NEMA
Physica Scripta, 97, 065003, June 2022

Vibrational Temperature Estimation of Nitrogen Molecules in Radio-Frequency (RF) Produced Plasma
NANDINI YADAVA, SACHIN S. CHOUHAN, AMULYA SANYASI, UTTAM SHARMA, JAYASHREE SHARMA, MALAY B. CHOWDHURI, JOYDEEP GHOSH and ANKUR PANDYA
Plasma and Fusion Research, 17, 2401095, June 2022

Measurement of Plasma Stream Parameters by Triple Probe in a Pulsed Plasma Accelerator
SUMIT SINGHA, AZMIRAH AHMED, SURAMONI BORTHAKUR, NIROD KUMAR NEOG, TRIDIP KUMAR BORTHAKUR
IEEE Transactions on Plasma Science, 50, 1440, June 2022

Formation of Nonlinear Stationary Structures in Ionospheric Plasma

GOBINDA MANNA, SUMAN DEY, JYOTIRMOY GOSWAMI, SWARNIV CHANDRA, JIT SARKAR, AMRITA GUPTA
IEEE Transactions on Plasma Science, 50, 1464, June 2022

Deuterium Ion Irradiation Impact on the Current-Carrying Capacity of DI-BSCCO Superconducting Tape
M. RAJPUT, H.L. SWAMI, R. KUMAR, A. BANO, S. VALA, M. ABHANGI, UPENDRA PRASAD, RAJESH KUMAR, R. SRINIVASAN
Nuclear Engineering and Technology, 54, 2586, July 2022

Laser Cluster Interaction in Ambient Magnetic Fields for Accelerating Electrons in Two Stages without External Injection
KALYANI SWAIN, SAGAR SEKHAR MAHALIK and MRITYUNJAY KUNDU
Scientific Reports, 12, 11256, July 2022

Laser Welded Lip Seal for UHV Class Fusion Vessels - A Methodical Study
ASHISH YADAV, JAYDEEP JOSHI, ARUN CHAKRABORTY, HARSHAD NATU
Fusion Engineering and Design, 180, 113163, July 2022

Performance of Etched Silica FBG for Simultaneous Strain Temperature Measurement
KOUSTAV DEY, B. RAMESH and SOURABH ROY
Silicon, 14, 4349, July 2022

Fluorescence Spectroscopy Based Characterisation Method for Aggregation Behaviour of Rhodamine B (RhB) In Water, Ethanol, and Propanol
SEIKH MUSTAFA RADIUL, JUGAL CHOWDHURY, ANGANA GOSWAMI and SIMANTA HAZARIKA
Laser Physics, 32, 075602, July 2022

Silanized Halloysite Nanotubes as 'Nano-Platform' for the Complexation and Removal of Fe (II) and Fe (III) Ions from Aqueous Environment
GAURAV PANDEY, MAITHRI THARMAVARAM, GARGI PHADKE, DEEPAK RAWTANI, MUKESH RANJAN, K. P. SOORAJ
Separation and Purification Technology, 293, 121141, July 2022

Plasma Asymmetry and Electron and Ion Energy Distribution Function in Capacitive Discharges Excited By Tailored Waveforms
SARVESHWAR SHARMA, NISHANT SIRSE, ANIMESH KULEY and MILES M TURNER
Journal of Physics D: Applied Physics, 55, 275202, July 2022

Anomalous Time of Flight Behavior of Fast Ions in Laser Produced Aluminum Plasma
GARIMA ARORA, JINTO THOMAS and HEM CHANDRA JOSHI
Physics of Plasmas, 29, 072101, July 2022

Modelling and Experimental Investigations of Composition-Dependent Heat and Mass Transfer during Cu–Ni Alloy Nanoparticle Synthesis in a Transferred Arc Helium Plasma
G D DHAMALE, SUBRAT DAS, ANTHONY B MURPHY, SATYA P R KANDADA, C BALASUBRAMANIAN and S GHORUI
Journal of Physics D: Applied Physics, 55, 375203, July 2022

Dynamics of Nanoscale Triangular Features on Ge Surfaces
SUKRITI HANS, BASANTA KUMAR PARIDA, VIVEK PACHCHIGAR, SEBIN AUGUSTINE, SOORAJ K P and MUKESH RANJAN
Nanotechnology, 33, 405301, July 2022

Exploring the Superhydrophilicity of Nanosecond Laser Textured Silicon: A Raman Analysis
RUDRASHISH PANDA, JINTO THOMAS, and HEM CHANDRA JOSHI
Applied Optics, 61, 6770, August 2022

Wave Breaking Limit in Arbitrary Mass Ratio Warm Plasmas
ASHISH ADAK, NIDHI RATHEE, SUDIP SENGUPTA
Contributions to Plasma Physics, 62, e202100220, August 2022

Development of Fast Steerable Launcher for ECRH System
HARDIK MISTRY, DHARMESH PUROHIT, HARSHIDA PATEL, JATIN PATEL, K.G. PARMAR, DILIP RAVAL, MANOJ KUMAR GUPTA, B.K. SHUKLA
Fusion Engineering and Design, 181, 113210, August 2022

Performance Testing of the Liquid Nitrogen Cooled Sorption Cryopump for Application in SST-1 Tokamak
VISHAL GUPTA, RANJANA GANGRADEY, SAMIRAN S. MUKHERJEE, JYOTI SHANKARMISHRA, PRATIK A.NAYAK, PARESH PANCHAL, VIPUL L.TANNA, YUVAKIRAN PARAVASTU, DILIP C.RAVAL, ZIAUDDIN KHAN, SIJU GEORGE, ATUL GARG, LN SRIKANTH, AVIJIT DEWASI, SHASHI KANTVERMA, ROHAN DUTTA and HEMANG AGRAVAT
Fusion Engineering and Design, 181, 113212, August 2022

Numerical Estimation of Droplet Motion on Linear Wettability Gradient Surface in Microgravity Environment
VISHAKHA BAGHEL, MUKESH RANJANA
Materials Today Communications, 32, 103916, August 2022

Defect Engineered Blue Photoluminescence in ZnO:Al/TiO2 Heterostructures
C. P. SAINI, S. BHOWMICK, A. BARMAN, N. KUMAR, A. DAS, S. A. KHAN, A. CLAVERIE, D. KANJILAL, R. N. MAHATO, K. SINGH, and A. KANJILAL
Journal of Applied Physics, 132, 065302, August 2022

Edge Biasing and Its Impact on the Edge and SOL Turbulence
VIJAY SHANKAR, NIRMAL BISAI, SHRISH RAJ and ABHIJIT SEN
Nuclear Fusion, 62, 086030, August 2022

Self-Sustained Non-Equilibrium Co-Existence of Fluid and Solid States in A Strongly Coupled Complex Plasma System
M. G. HARIPRASAD, P. BANDYOPADHYAY, V. S. NIKOLAEV, D. A. KOLOTINSKII, S. ARUMUGAM, G. ARORA, S. SINGH, A. SEN and A. V. TIMOFEEV
Scientific Reports, 12, 13882, August 2022

Enhancing Dropwise Condensation of Vapor from Moist Air over a Copper Substrate by Temperature-Controlled Chemical Etching
PUNJ LATA SINGH, BASANT SINGH SIKARWAR, MUKESH RANJAN, K. MURALIDHAR
Thermal Science and Engineering Progress, 34, 101403, September 2022

Fabrication and Characterization of BSCCO-2223 Tape Compact Coils
UPENDRA PRASAD, PIYUSH RAJ, ANEES BANO, ARUN PANCHAL, DEVEN KANABAR, R. SRINIVASAN

IEEE Transactions on Applied Superconductivity, 32, 4605505, September 2022

Hydrophobic to Super hydrophobic and Hydrophilic Transitions of Ar Plasma-Nanostructured PTFE Surfaces
VIVEK PACHCHIGAR, UMESH K. GAUR, AMRUTHA T. V., SOORAJ K. P, SUKRITI HANS, SANJEEV K. SRIVASTAVA, MUKESH RANJAN
Plasma Processes and Polymers, 19, 2200037, September 2022

Design, Development and Characterization of Resistive Arm Based Planar and Conformal Metasurfaces for RCS Reduction
PRIYANKA TIWARI, SURYA KUMAR PATHAK and VARSHA SIJU
Scientific Reports, 12, 14992, September 2022

Thermo-Physical Properties and Heat Transfer Potential of Novel Silica-Ethylene Glycol Mono Nanofluid: Experiments and Multi-Layer Perceptron (MLP) Modelling
S. MUKHERJEE, P.C. MISHRA, N. ALI, N.F. ALJUWAYHEL, S.A. EBRAHIM, P. CHAUDHURI
Colloids and Surfaces A: Physicochemical and Engineering Aspects, 648, 129412, September 2022

Square Lattice Formation in a Monodisperse Complex Plasma
SWARNIMA SINGH, P. BANDYOPADHYAY, KRISHAN KUMAR and A. SEN
Physical Review Letters, 129, 115003, September 2022

Coupling of 'Cold' Electron Plasma Wave via Stationary Ion Inhomogeneity to the Plasma Bulk
SANJEEV KUMAR PANDEY, JAGANNATH MAHAPATRA and RAJARAMAN GANESH
Physica Scripta, 97, 105602, September 2022

Initial Results from Time-Resolved LaBr Based Hard X-Ray Spectrometer for ADITYA-U Tokamak
S. PUROHIT, M. K. GUPTA, M. B. CHOWDHURI, I. MANSURI, M. BHANDARKAR, B. K. SHUKLA, K. SHAH, R. MANCHANDA, U. C. NAGORA, S. K. PATHAK, K. A. JADEJA, R. L. TANNA, J. GHOSH and ADITYA-U TEAM
Review of Scientific Instruments, 93, 093512, September 2022

Investigation of Subsonic to Supersonic Transition of a Low-Pressure Plasma Torch Jet
RAM KRUSHNA MOHANTA, G. RAVI
IEEE Transactions on Plasma Science, 50, 2941, September 2022

Surface Tailored Graphite-Polymer Composite Electrodes through Cold Plasma for Electrochemical Applications
SUNIL LUHAR, RAMKRISHNA RANE, DIVESH N. SRIVASTAVA
Plasma Processes and Polymers, 19, e2200048, September 2022

Impact of Local Timescales in a Cellular Automata Model of Excitable Media
PROMIT MOITRA, ABHIJIT SEN
Chaos, Solitons and Fractals, 162, 112418, September 2022

Preliminary Design and Analysis of 20 K Helium Cooled MgB2 Based Superconducting Current Feeder System for Tokamak Application
N. BAIRAGI, V. L. TANNA and D. RAJU
IEEE Transactions on Applied Superconductivity, 32, 4802305, September 2022

The Joining of Copper to Stainless Steel by Solid-State Welding Processes: A Review
GAURANG R. JOSHI, VISHVESH J. BADHEKA, RAGHAVENDRA S. DARJI, ANKIT D. OZA, VIVEK J. PATHAK, DUMITRU DORU BURDUHOS-NERGIS, DIANA PETRONELA BURDUHOS-NERGIS, GAUTAM NARWADE and GOPINATH THIRUNAVUKARASU
Materials, 15, 7234, October 2022

Cross-Sections for Production of 115m in by Quasi-Monoenergetic Neutrons within 7-20 MeV AKASH HINGU, BHARGAV SONI, SIDDHARTH PARASHARI, RAJNIKANT MAKWANA, P.M. PRAJAPATI, VIBHUTI VASHI, MAYUR MEHTA, R. PALIT, S.V. SURYANARAYANA, B.K. NAYAK, K. KATOVSKY, S. MUKHERJEE
Radiation Physics and Chemistry, 199, 110270, October 2022

Copper Electroplating Technique for Development of HTS Current Leads Bottom Joints Using MgB2 Wires
NITIN BAIRAGI, D. SONARA, H. NIMAVAT, V.L. TANNA, U. PRASAD, D. RAJU
Physica C: Superconductivity and its Applications, 601, 1354108, October 2022

Modulation of Optoelectronic Properties of ZnO/PbO Core/Shell Nanocomposite for Memcapacitive Application B. PATHAK, P.K. KALITA, NAYAN MANI NATH, NGANGOM AOMOA, J.P. ROY CHOUDHURY
Materials Science in Semiconductor Processing, 149, 106892, October 2022

Plasma Nano-Patterning for Altering Hydrophobicity of Copper Substrate for Moist Air Condensation
DEEPAK KUMAR SHARMA, VIVEK PACHCHIGAR, MUKESH RANJAN, BASANT SINGH SIKARWAR
Applied Surface Science Advances, 11, 100281, October 2022

High Temperature Oxidation Behavior of Thermal and Plasma Processed Aluminide Coated Ti6Al4V Alloys
PAYANK PATEL, ARUNSINH ZALA, TEJAS PAREKH, S.D. KAHAR, N.I. JAMNAPARA
Surface and Coatings Technology, 447, 128839, October 2022

Evaluation of Optical Transmission across the ITER Hard X-Ray Monitor System Designed for the First Plasma Scenarios
P. NOWAK VEL NOWAKOWSKI, D. MAKOWSKI, B. JABLONSKI, P. SZAJERSKI, SANTOSH P. PANDYA, R. O'CONNOR, R. TIEULENT and R. BARNSLEYP
Review of Scientific Instruments, 93, 103512, October 2022

Motility-Induced Phase Separation of Self-Propelled Soft Inertial Disks
SOUMEN DE KARMAKAR and RAJARAMAN GANESH
Soft Matter, 18, 7301, October 2022

Reentrant Phase Separation of a Sparse Collection of Nonreciprocally Aligning Self-Propelled Disks
SOUMEN DE KARMAKAR and RAJARAMAN GANESH
Physical Review E, 106, 044607, October 2022

Large Area Multi-Filamentary Plasma Source for Large Volume Plasma Device – Upgrade
A. K. SANYASI, P. K. SRIVASTAVA, AYAN ADHIKARI, L. M. AWASTHI, P. LEUVA, P. SANTRA, B. DOSHI, M. K. GUPTA and R. SUGANDHI
Review of Scientific Instruments, 93, 103546,

October 2022

Deposited Layer Substrate (DeLaS)—A Module for Radiation Measurement
SHWETANG N. PANDYA, SANTOSH P. PANDYA, P. A. RAYJADA and JAGANNATHAN GOVINDARAJAN
Review of Scientific Instruments, 93, 103537, October 2022

Adaptive Capon Beamforming for Lensless Electron Cyclotron Emission Imaging with High Spatial Resolution
H. IDEI, M. FUKUYAMA, S. SAKAI, K. MISHRA, K NISHIMURA, R. IKEZOE, T. ONCHI, T. IDO, and K. HANADA
Review of Scientific Instruments, 93, 103531, October 2022

Powder Mixed Electrical Discharge Machining of Inconel 718: Investigation on Material Removal Rate and Surface Roughness
RAGHAVENDRA S. DARJI, GAURANG R. JOSHI, SAGRAM HEMBROM, MANOJ KUMAR, SACHIN M. SHINDE, R. RAMESH
International Journal on Interactive Design and Manufacturing (IJIDeM), s12008-022-01059-w, October 2022

Quasi-Longitudinal Propagation of Nonlinear Whistlers with Steep Electrostatic Fluctuations
GAYATRI BARSAGADE and D. SHARMA
Physics of Plasmas, 29, 112104, November 2022

Scaling of Reconnection Parameters in Magnetic Island Coalescence: Role of In-Plane Shear Flow
JAGANNATH MAHAPATRA, RAJARAMAN GANESH and ABHIJIT SEN
Physics of Plasmas, 29, 112107, November 2022

Investigating the Effect of Density Variation on Pitch Angle Scattering Events of Runaway Electrons as Observed Through Electron Cyclotron Emission Diagnostic at ADITYA-Upgrade Tokamak
VARSHA SIJU, SANTOSH P. PANDYA, S. K. PATHAK, UMESH NAGORA, SHISHIR PUROHIT, ANSH PATEL, M. K. GUPTA, K. TAHILIANI, R. L. TANNA, KUMARPALSINH JADEJA, ROHIT KUMAR, and J. GHOSH
Review of Scientific Instruments, 93, 113529, November 2022

On the Growth and Texturing of Ultra-Thin Zinc Oxide Films in Spin Coating
NIMITHAK. VIJAY, P.N. MAYA, S. AKKIREDDY, M.D. BENOY
Thin Solid Films, 762, 139554, November 2022

Blob Tracking and Formation in Edge and SOL Plasmas using Q-Factor
N. BISAI and A. SEN
Plasma Physics and Controlled Fusion, 64, 115011, November 2022

Parallel Algorithm for Synthetic Image Generation with Application to Tokamak Plasma Diagnostics
KIRTAN DELWADIA, DHRUVIL BHATT, SHISHIR PUROHIT, BHASKAR CHAUDHURY
Concurrency and Computation: Practice and Experience, 34, e7217, November 2022

Design and Development of LN2 Cooled Cryopump for Application in High Heat Flux Test Facility
S.S. MUKHERJEE, V. GUPTA, P. PANCHAL, J.S. MISHRA, P. NAYAK, J. AGARWAL, H. AGRAVAT, A. DEWASI, R. DUTTA, A.B. DESAI, S.K. VERMA, R. SWAMY, P. MOKARIYA, N. PATEL, T. PATEL, S.M. BELSARE, S.S. KHIRWADKAR, R. GANGRADEY
Fusion Engineering and Design, 184, 113315, November 2022

Investigation on Stability of Weld Morphology, Microstructure of Processed Zones, And Weld Quality Assessment for Hot Wire Gas Tungsten Arc Welding of Electrolytic Tough Pitch Copper
RAGHAVENDRA DARJI, VISHVESH BADHEKA, KUSH MEHTA, JAYDEEP JOSHI, ASHISH YADAV and ARUN KUMAR CHAKRABORTY
Materials and Manufacturing Processes, 37, 908, 2022

The Full-Voltage Operation of the Acceleration Grid Power Supply for SPIDER Experiment
A. FERRO, M. BOLDRIN, S.D. BELLO, R. CASAGRANDE, M. DAN, A. MAISTRELLO, C. TALIERCIO, M. VIGNANDO, L. ZANOTTO, V. TOIGO, H. DHOLA, B. RAVAL, N.P. SINGH N, A PATEL, A. SHARMA
IEEE Transactions on Plasma Science, 50, 3941, November 2022

Improved Heat and Particle Flux Mitigation in High Core Confinement, Baffled, Alternative Divertor Configurations in the TCV Tokamak
HARSHITA RAJ, C. THEILER, A. THORNTON, O. FEVRIER, S. GORNO, F. BAGNATO, P. BLANCHARD, C. COLANDREA, H. DE OLIVEIRA, B.P. DUVAL, B. LABIT, A. PEREK, H. REIMERDES, U. SHEIKH, M. VALLAR, B. VINCENT, the TCV TEAM and the EUROFUSION MST1 TEAM
Nuclear Fusion, 62, 126035, November 2022

First Results of Fast Visible Imaging Diagnostic in ADITYA-U Tokamak
DEVILAL KUMAWAT, KUMUDNI TAHILIANI, SURESH I, S. K. PATHAK, SANTOSH P. PANDYA, SAMEER KUMAR, RAJU DANIEL, R. L. TANNA, JOYDEEP GHOSH, UMESH NAGORA, MANOJ K. GUPTA, ROHIT KUMAR, KUMARPALSINH JADEJA and SUMAN AICH
Review of Scientific Instruments, 93, 113548, November 2022

Initial Results from Near-Infrared Spectroscopy on ADITYA-U Tokamak
N. RAMAIYA, R. MANCHANDA, M. B. CHOWDHURI, N. YADAVA, R. DEY, A. KUMAR, K. SHAH, S. PATEL, K. A. JADEJA, K. M. PATEL, R. KUMAR, S. AICH, S. K. PATHAK, R. L. TANNA, J. GHOSH and ADITYA-U TEAM
Review of Scientific Instruments, 93, 113552, November 2022

Parametric Decay Induced First-Order Phase Transition in Two-Dimensional Yukawa Crystals
SRIMANTA MAITY, GARIMA ARORA
Scientific Reports, 12, 20430, November 2022

Determination of Eddy-Current Distribution in Electrically Isolated Vessel Sections of ADITYA-U Tokamak
ROHIT KUMAR, J. GHOSH, TANMAY MACWAN, SUMAN AICH, R.L. TANNA, KAUSHAL PATEL, KUMARPAL JADEJA, S.K. JHA
IEEE Transactions on Plasma Science, 50, 4279, November 2022

Fluorescence and Nonlinear Optical Response of Graphene Quantum Dots Produced by Pulsed Laser Irradiation in Toluene
PARVATHY NANCY, NITHIN JOY, SIVAKUMARAN VALLUVADASAN, REJI PHILIP, SABU THOMAS, RODOLPHE ANTOINE and NANDAKUMAR KALARIKKAL
Molecules, 27, 7988, November 2022

Effect of Radiation-Reaction on Charged Particle Dynamics in a Focused Electromagnetic Wave
SHIVAM KUMAR MISHRA, SARVESHWAR SHARMA and SUDIP SENGUPTA

Scientific Reports, 12, 19263, November 2022

Ion Implantation of 109Ag Stable Isotope as a Tracer in SS316L Biomedical Implant for Failure Detection
BHARTI MALVI, RAMESH CHAUDHARI, BALASUBRAMANIAN C, ASHUTOSH KUMAR, ASOKAN K, SWAGAT DAS, MANAS PALIWAL, SUPERB K. MISRA
Materials Today Communications, 33, 104563, December 2022

Analysis of Effective Thermal Conductivity of Pebble Bed by Artificial Neural Network and its Computational and Experimental Verification
CHIRAG SEDANI, MAULIK PANCHAL, VIPUL TANNA, PARITOSH CHAUDHURI, MANOJ KUMAR GUPTA
Case Studies in Thermal Engineering, 40, 102548, December 2022

Trapping of Waves in a Flowing Dusty Plasma
KRISHAN KUMAR, P. BANDYOPADHYAY, SWARNIMA SINGH and A. SEN
Physics of Plasmas, 29, 123703, December 2022

Measurement System for Ion Beam Profiles Using Fixed Parallel Wires and Faraday Cup Array
BHARAT SINGH RAWAT, S. K SHARMA, B. CHOKSI, V. PRAHLAD and U. K. BARUAH
AIP Advances, 12, 125103, December 2022

Enhancement of Thermal Performance of Engine Coolant Using Silica Nanoparticles
S. MUKHERJEE, S.R. PANDA, P. C. MISHRA, M.M. NOOR, P.C. CHAUDHURI
Sadhana - Academy Proceedings in Engineering Sciences, 47, 215, December 2022

Sonic Velocity Measurement in Molten Pb-Li (16) at High Temperature for Ultrasonic Flowmeter Applications
S. SAHU, K. BHOPE, A. PRAJAPATI, M. MEHTA, H. TAILOR, R. BHATTACHARYAY and S.S. KHIRWADKAR
Flow Measurement and Instrumentation, 88, 102271, December 2022

Auto-Correlations of Microscopic Density Fluctuations for Yukawa Fluids in the Generalized Hydrodynamics Framework with Viscoelastic Effects
ANKIT DHAKA, P. V. SUBHASH, P. BANDYOPADHYAY and A. SEN
Scientific Reports, 12, 21883, December 2022

Collective Behavior of Soft Self-Propelled Disks with Rotational Inertia
SOUMEN DE KARMAKAR, ANSHIKA CHUGH and RAJARAMAN GANESH
Scientific Reports, 12, 22563, December 2022

Boron Carbide as High-Energy Radiation Shielding Material for ITER
BHOOMI SANDIP GAJJAR, SANJEEV KUMAR VARSHNEY, SIDDHARTH KUMAR, MUKESH JINDAL, PRATIK VAGHASIYA, SIJU GEORGE, ZIAUDDIN KHAN and HITESH KUMAR B. PANDYA
IEEE Transactions on Plasma Science, 50, 5078, December 2022

Thermo-Fluidic Performance of SiO2–ZnO/ Water Hybrid Nanofluid on Enhancement of Heat Transport in a Tube: Experimental Results
S. MUKHERJEE, P.C. MISHRA, N.F. ALJUWAYHEL, N. ALI, P. CHAUDHURI
International Journal of Thermal Sciences, 182, 107808, December 2022

Global Gyrokinetic Simulations of Electrostatic Microturbulent Transport using Kinetic Electrons

in LHD Stellarator
TAJINDER SINGH, JAVIER H. NICOLAU, ZHIHONG LIN, SARVESHWAR SHARMA, ABHIJIT SEN and ANIMESH KULEY
Nuclear fusion, 62, 126006, December 2022

Complex Mode Dispersion Characteristics of Dielectric Loaded Radially Thick Helix
AJAY KUMAR PANDEY, RASILA R. HIRANI, SURYA K. PATHAK
IEEE Transactions on Antennas and Propagation, 70, 11968, December 2022

Processing of Bioresorbable Closed-Cell Mg Foam for Bone Implant Applications
DHAVAL MAKWANA, BHINGOLE PRAMOD, PARITOSH CHAUDHARI and C. S. SASMAL
Materials and Manufacturing Processes, 2157426, December 2022

Plasma Fireball-Mediated Ion Implantation for Nonvolatile Memory Application
SUDHEER, VIVEK PACHCHIGAR, BISWARUP SATPATI, SOORAJ KP, SEBIN AUGUSTINE, SUKRITI HANS, MUKESH RANJAN
Applied Surface Science, 607, 154999, January 2023

Radiation Analysis and Design Study of Unified Cooling and Baking Scheme for SMARTEX-C
RITESH KUMAR SRIVASTAVA, MANOJ KUMAR GUPTA, LAVKESH T. LACHHVANI, MANU BAJPAI, YOGESH YEOLE, BHARAT R. DOSHI, PRABAL K. CHATTOPADHYAY
Fusion Engineering and Design, 186, 113361, January 2023

Rheological behavior of dilute graphene-water nanofluids using various surfactants: An experimental evaluation
SHIKHA A. EBRAHIM, EMIL PRADEEP, SAYANTAN MUKHERJEE, NASER ALI,
Journal of Molecular Liquids, 370, 120987, January 2023

Study of Two-Electron Temperature Plasma Sheath Using Non-Extensive Electron Distribution in Presence of an External Magnetic Field
GUNJAN SHARMA, RUPALI PAUL, KISHOR DEKA, RAKESH MOULICK, SAYAN ADHIKARI, S. S. KAUSIK and B. K. SAIKIA
AIP Advances, 13, 015011, January 2023

Electromagnetic Pinned Solitons for Space Debris Detection
ABHIJIT SEN, RUPAK MUKHERJEE, SHARAD K. YADAV, CHRIS CRABTREE and GURUDAS GANGULI
Physics of Plasmas, 30, 012301, January 2023

Study of Magnetized Multi-Component Plasma Sheath Containing Charged Dust Particles in Presence of Oblique Magnetic Field: A Fluid Approach
A K SHAW, A K SANYASI and S KAR
Physica Scripta, 98, 015606, January 2023

A Simple Device for Simultaneous Measurement of Stokes Polarization Parameters
ASHA ADHIYA, MINSHA SHAH, ANKUR PANDYA, RAJWINDER KAUR
IEEE Transactions on Instrumentation and Measurement, 72, 7001606, January 2023

Power Exhaust and Core-Divertor Compatibility of the Baffled Snowflake Divertor in TCV
S GORNO, C COLANDREA, O FEVRIER, H REIMERDES, C THEILER, B P DUVAL, T LUNT, H RAJ, U A SHEIKH, L SIMONS, A THORNTON, the TCV TEAM and the EUROFUSION MST1 TEAM
Plasma Physics and Controlled Fusion, 65,

035004, January 2023

Effect of Pre-treatment and Duration of Pulse Plasma Nitriding on Duplex Plasma Treatment by Physical Vapor Deposition of TiN on AISI D2 Steel
KALYAN DAS, ALPHONSA JOSEPH, ABHISHEK GHOSH, GOURAB SAHA, RAMKRISHNA RANE, SUBROTO MUKHERJEE and MANOJIT GHOSH
Journal of Materials Engineering and Performance, s11665-022-07776-3, January 2023

Au/Ag SERS Active Substrate for Broader Wavelength Excitation
SEBIN AUGUSTINE, MAHESH SAINI, SOORAJ K.P., BASANTA KUMAR PARIDA, SUKRITI HANS, VIVEK PACHCHIGAR, BISWARUP SATPATI, MUKESH RANJAN
Optical Materials, 135, 113319, January 2023

Observation of Double Layer Formation in Low-Temperature E × B Plasma Based Negative Ion Sources
MIRAL SHAH, BHASKAR CHAUDHURY, MAINAK BANDYOPADHYAY, and ARUN CHAKRABORTY
Physics of Plasmas, 30, 010701, January 2023

Investigation of Dust Ion Acoustic Shock and Solitary Waves in A Viscous Dusty Plasma.
J GOSWAMI and S. S. KAUSIK
Physical Scripta, 98, 035602, February 2023

High-Temperature Solid-State Synthesis and Characterization of Mixed-Phase Sr2CeO4-SrCe0.85Y0.15O3-δ Ceramic: A Potential Proton-Conducting Ceramic Membrane
AROH SHRIVASTAVA, DEEPAK YADAV, PARITOSH CHAUDHURI and AMIT SIRCAR
Journal of Materials Science: Materials in Electronics, 34, 455, February 2023

A Wideband Hybrid Combiner Design for ITER Ion Cyclotron Radio Frequency Source
AKHIL JHA, AJESH PALLIWAR, ROHIT ANAND, J. V. S. HARIKRISHNA, MANOJ PATEL, HRUSHIKESH DALICHA, PARESH VASAVA, DIPAL SONI, SRIPRAKASH VERMA, GAJENDRA SUTHAR, KARTIK MOHAN, ROHIT AGARWAL, KUMAR RAJNISH, RAGHURAJ SINGH, RAJESH. G. TRIVEDI, and APARAJITA MUKHERJEE
Review of Scientific Instruments, 94, 024701, February 2023

Redescription of Acanthochitona mahensis Winckworth, 1927 (Polyplacophora, Acanthochitonidae) from Indian Coasts
LIJU THOMAS, BRUNO ANSEEUW, RANJEET KUTTY, SOORAJ KANDATHIL PARAMBIL
Zootaxa, 5244, 41, February 2023

Study of Increment of Emission Intensity in a Cold Atmospheric Pressure Helium Plasma Jet Using the ADAS
NARAYAN BEHERA, G. VEDA PRAKASH
Europhysics Letters, 141, 44001, February 2023

Bifurcation Behaviour of Resonant Magnetic Perturbation Control of Edge Localized Modes in Tokamaks: Nonlinear Simulation Results
ANANTANARAYANAN THYAGARAJA, ABHIJIT SEN and DEBASIS CHANDRA
Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences, 381, 20220161, February 2023

Studies on Ion Flow Dynamics in a Disk-Shaped Inertial Electrostatic Confinement Fusion Device under the Influence of a Triple Grid Arrangement
L. SAIKIA, D. BHATTACHARJEE, S. R.

MOHANTY and S. ADHIKARI
Physics of Plasmas, 30, 022110, February 2023

Signatures of an Energetic Charged Body Streaming in a Plasma
VIKRAM DHARODI, ATUL KUMAR, and ABHIJIT SEN
Physical Review E, 107, 025207, February 2023

Modulational Instability of a Yukawa Fluid Excitation under the Quasi-Localized Charged Approximation (QLCA) Framework
SANDIP DALUI, PRINCE KUMAR and DEVENDRA SHARMA
Physica Scripta, 98, 25606, February 2023

Role of Magnetohydrodynamic Activity in Sawtooth Induced Heat Pulse Propagation in ADITYA Tokamak
S. PATEL, J. GHOSH, M. B. CHOWDHURI, K. B. K. MAYYA, R. MANCHANDA, H. K. B. PANDYA, R. L. TANNA, V. KUMAR, S. JOISA, S. PUROHIT, D. RAJU, S. JHA, P. K. ATREY, C. V. S. RAO, P. VASU, D. CHENNA REDDY, S. B. BHATT,Y. C. SAXENA and ADITYA TEAM
Nuclear Fusion, 63, 036001, March 2023

Investigation on the Effects of Pretreatment on the Surface Characteristics of Duplex Plasma-Treated AISI P20 Tool Steel
KALYAN DAS, SOUMYADEEP SEN, ALPHONSA JOSEPH, ABHISHEK GHOSH, RAMKRISHNA RANE, KOUSHIK BISWAS, SUBROTO MUKHERJEE, MANOJIT GHOSH
Materialia, 27, 101679, March 2023

Functional Estimation of Space and Time Varying Thermal Properties Using Modified Conjugate Gradient Method
PARTH SATHAVARA, AJIT KUMAR PARWANI, PARITOSH CHAUDHURI
International Journal of Thermal Sciences, 185, 108116, March 2023

Low-Pressure Adsorption of Hydrogen Isotopologues on LTA4A Zeolites - A Grand Canonical Monte Carlo Simulation Study
V. GAYATHRI DEVI, ARAVAMUDAN KANNAN, DEEPAK YADAV, AMIT SIRCAR
Fusion Engineering and Design, 188, 113401, March 2023

Effect of External Longitudinal Magnetic Field on the Dynamics of Pulsed Plasma Stream
A. AHMED, S. SINGHA, N.K. NEOG, T.K. BORTHAKUR
Physica Scripta, 98, 35601, March 2023

Scaling of Anisotropic Wetting Behavior of Water Drop Configuration Arising from Parallel Groove-Textured Stainless Steel Surfaces
K. SURESHVARR, R. KANNAN, JOSEPH ALPHONSA and P. SIVASHANMUGAM
Bio- and Tribo-Corrosion, 9, 1, March 2023

Quasi-Localized Charge Approximation Approach for the Nonlinear Structures in Strongly Coupled Yukawa Systems
PRINCE KUMAR and DEVENDRA SHARMA
Physics of Plasmas, 30, 033702, March 2023

Fluorescent H-aggregates of Pure Rhodamine B (RhB) in Glycerol, Ethylene Glycol, Methanol and Butanol under Ambient Condition
SEIKH MUSTAFA RADIUL, JUGAL CHOWDHURY and SIMANTA HAZARIKA
Journal of Molecular Structure, 1275, 134606, March 2023

Synchronization of Dust Acoustic Waves in a Forced Korteweg-de Vries-Burgers Model
AJAZ MIR, SANAT TIWARI, ABHIJIT SEN,

CHRIS CRABTREE, GURUDAS GANGULI, and JOHN GOREE
Physical Review E, 107, 035202, March 2023

Kelvin-Helmholtz Instability in a Compressible Dust Fluid Flow
KRISHAN KUMAR, P. BANDYOPADHYAY, SWARNIMA SINGH, VIKRAM S. DHARODI and A. SEN
Scientific Reports, 13, 3979, March 2023

Improving Electrochemical Sensitivity of Screen-Printed Carbon Electrodes by Atmospheric Pressure Plasma Jet Treatment and Electrochemical Detection of Dopamine
KALYANI BARMAN, SUNIL LUHAR, RAMKRISHNA RANE, DIVESH N. SRIVASTAVA, SUDHIR K. NEMA, SUDEEP BHATTACHARJEE
Plasma Processes and Polymers, 20, 2200161, March 2023

Conceptual Design of Multichannel Fast Electron Bremsstrahlung Detection System to Study Fast Electron Dynamics during Lower Hybrid Current Drive in ADITYA-U Tokamak
JAGABANDHU KUMAR, SANTOSH P. PANDYA and P.K. SHARMA
Journal of Instrumentation, 18, P03040, March 2023

Localized Absorption of Laser Energy in X-Mode Configuration of Magnetized Plasma
AYUSHI VASHISTHA, DEVSHREE MANDAL, SRIMANTA MAITY and AMITA DAS
Plasma Physics and Controlled Fusion, 65, 035006, March 2023

Phase Switching Phenomenon in a System of Three Coupled DC Glow Discharge Plasmas
NEERAJ CHAUBEY, PANKAJ KUMAR SHAW, S. MUKHERJEE and A. SEN
Chaos: An Interdisciplinary Journal of Nonlinear Science, 33, 033125, March 2023

Characterization of Plasma Discharge in a Multi Dipole Line Cusp Magnetic Field Created by an RF Source Coupled by a Spiral Antenna
M.A. ANSARI, AMIT D PATEL, A. DAS ALLI, PRABAL K. CHATTOPADHYAY, N. RAMASUBRAMANIAN, DANIEL RAJU, and RAJ SINGH
IEEE Transactions on Plasma Science, 51, 625, March 2023

E.1.2 Conference Papers

Effects of Axial Magnetic Field in a Magnetic Multipole Line Cusp Ion Source
BHARAT SINGH RAWAT, S K SHARMA, B CHOKSI, P BHARATHI, B SRIDHAR, L N GUPTA, D THAKKAR, S L PARMAR, V PRAHLAD and U K BARUAH
Journal of Physics: Conference Series, 2244, 012082, April 2022

Characterization of Hydrogen Plasma in an ECR based Large Volume Plasma Chamber
SHWETA SHARMA, D SAHU, R NARAYANAN, S KAR, M BANDYOPADHYAY, A CHAKRABORTY, M J SINGH, R D TAREY and A GANGULI
Journal of Physics: Conference Series, 2244, 012055, April 2022

Optimization and Simulation of Helix Loaded with Dielectric Dispersion Characteristics Using TLBO Algorithm
AJAY K. PANDEY, RASILLA R. HIRANI, SURYA K. PATHAK
3rd URSI Atlantic and Asia Pacific Radio Science Meeting (AT-AP-RASC), Spain, 21948659, 30

May 2022 - 04 June 2022 (published in July 2022)

Characterisation of Supersonic Helium Beam Injection Section for Edge Diagnostics of SST-1 Tokamak
M. PATEL, J. THOMAS, H. JOSHI
IEEE International Conference on Plasma Science (ICOPS), USA, 21862744, 22-26 May 2022 (published in July 2022)

Analysis of Electric Field Stress of 145 kV OIP Bushing under AC & DC Voltages
ARITRA CHAKRABORTY, S AMAL, SAURABH KUMAR, PAUL D. CHRISTIAN, ANANYA KUNDU, ASHOK MANKANI
2nd International Conference on Advances in Electrical, Computing, Communication and Sustainable Technologies (ICAECT), Bhilai, India, 9807946, 21-22 April 2022 (published in July 2022)

Plasmonic Effect of Ag-Nanoparticles on Self-Powered Photodetection Performance of NiO/Si Heterostructure Device
SAVITA CHAOUDHARY, AVIJIT DEWASI, VIPUL RASTOGI, and ANIRBAN MITRA
CLEO: Applications and Technology 2022, San Jose, California United States, 15–20 May 2022 Conference on Lasers and Electro-Optics, Technical Digest Series, paper JW3A.27, Optica Publishing Group, 2022. ISBN: 9781957171050

Confinement of Washer-Gun Plasma and Tailoring of Location and Scale Length of Electron Density Gradient to Meet the Requisites of Microwave Plasma Interaction
V ANITHA, P J RATHOD, A D PATEL, U.K. GOSWAMI, V PATEL, A. VYAS
IEEE International Conference on Plasma Science (ICOPS), USA, 1-2 pp., 22-26 May 2022 (Published in July 2022)

Study of Electrode Biasing in the Edge and SOL Regions of a Tokamak
VIJAY SHANKAR, NIRMAL BISAI, SHRISH RAJ, ABHIJIT SEN
48th EPS Conference on Plasma Physics, P5b.116, 27 June 2022 - 1 July 2022

CPU Thermal Management: Investigation of Fins Arrangements and Hybrid Water-Phase
Change Materials Cooling
NASER ALI, HUSAIN BAHZAD, ALI ALSAYEGH, SAYANTAN MUKHERJEE, SHIKHA A. EBRAHIM, NAWAF F. ALJUWAYHEL
International Conference on Computing, Electronics & Communications Engineering (iCCECE), held at United Kingdom, 17-18 August 2022. pp. 59-64, published in September 2022

Thermophysical and Transient Heat Transfer Characteristics of Aqueous SiO2 Nanofluid in Energy Management Applications
SAYANTAN MUKHERJEE, SMITA RANI PANDA, PURNA CHANDRA MISHRA, SWARNENDU SEN, PARITOSH CHAUDHURI
Proceedings of the Institution of Mechanical Engineers, Part E: Journal of Process Mechanical Engineering, September 2022

Contrast Limited Brightness Preserving Dynamic Fuzzy Histogram Equalization Technique for Enhancement of Steady State Tokamak Plasma Images
M.S.GODWINPREMI,E.LOGASHANMUGAM, MANOJ KUMAR GUPTA, V. VIJAYA BASKAR and SUNIL SUSMITHAN
Proceedings of International Conference on Communication and Computational

Technologies (ICCCT 2022), Series: Algorithms for Intelligent Systems, Springer, 925–935, September 2022

Stability and Sedimentation Characteristics of Water Based Al2 O3 and TiO2 Nanofluids
SAYANTAN MUKHERJEE, SHANTA CHAKRABARTY, PURNA CHANDRA MISHRA, PARITOSH CHAUDHURI
Proceedings of the Institution of Mechanical Engineers, Part N: Journal of Nanomaterials, Nanoengineering and Nanosystems, October 2022

Behavior of Tungsten Carbide Thin Films Grown at Different Substrate Temperatures
SHRISTI BIST, RATNESH K PANDEY, SEJAL SHAH, MANGABABU A., PARSWAJIT KALITA, AMIT CHAWLA, DEVESH KUMAR AVASTHI
International Conference on Electrical Engineering and Photonics (EExPolytech), St. Petersburg, Russian Federation, 297-300, 20-21 October 2022 (Published in November 2022)

Development and Testing of a Sensor for Liquid Helium Measurement
N. KAPILAN, HARIKRISHNAN R, K. V. SRINIVASAN, S. KASTHURIRENGAN, H. J. DAVE, A. K. SAHU
IEEE 2nd Mysore Sub Section International Conference (MysuruCon), Mysuru, pp. 1-5, 16-17 October 2022

Leaky Mode Radiation Properties of Dielectric Loaded Helix
AJAY KUMAR PANDEY, SURYA KUMAR PATHAK
IEEE Region 10 International Conference (TENCON 2022), Hong Kong, pp. 1-3, 01-04 November 2022

Effect of Tantalum Addition on the Mechanical Properties of Tungsten/Tantalum Composite Thin Films
S. LAKSHMI KANTH KONURU, UMASANKAR V., BISWANATH SARKAR, ARUN SARMA
Proceedings of the Institution of Mechanical Engineers, Part E: Journal of Process Mechanical Engineering, February 2023

ECRH Experiments on Tokamaks SST-1 & ADITYA-U and ECRH Upgradation Plan for SST-1
BRAJ KISHORE SHUKLA, JATIN PATEL, HARSHIDA PATEL, DHARMESH PUROHIT, HARDIK MISTRY, K.G. PARMAR, SST-1 TEAM and ADITYA-U TEAM
EPJ Web of Conferences, 277, 02005, February 2023

Simple Beam Switching Cylindrical Dielectric Resonator Antenna Using Helix
AJAY KUMAR PANDEY, SURYA KUMAR PATHAK
International Microwave and Antenna Symposium (IMAS), Cairo, Egypt, pp. 53-55, 7-9 February 2023 (published in March 2023)

E.1.3 Book Chapters

Laser-Produced Plasma: Fabrication of Size-Controlled Metallic Nanoparticles
KAUSHIK CHOUDHURY, ATUL SRIVASTAVA, RAJESH KUMAR SINGH, AJAI KUMAR
Plasma at the Nanoscale: Micro and Nano Technologies, pp. 37-61, Elsevier, August 2022. ISBN: 9780323899307

Dust Ion-Acoustic Multisoliton Interactions in the Presence of Superthermal Particles
DHARITREE DUTTA and K. S. GOSWAMI
International Conference on Nonlinear

Dynamics and Applications (ICNDA 2022): (Springer Proceedings in Complexity), 289-298, Springer, October 2022. ISBN: 9783030997915

Millimeter Wave Overmoded Circular Waveguide Tapers for ECRH Applications
PUJITA BHATT, AMIT PATEL, KEYUR MAHANT, K. SATHYANARAYANA and S. V. KULKARNI
Emerging Technology Trends in Electronics, Communication and Networking, Lecture Notes in Electrical Engineering, 952, 13-22, Springer, December 2022, ISBN: 9789811967368

Pneumatic Calibrator for Heterodyne Interferometer
KIRAN PATEL, UMESH NAGORA, H. C. JOSHI and SURYA PATHAK
Advances in VLSI and Embedded Systems, Lecture Notes in Electrical Engineering, 962, 123-130, Springer, December 2022, ISBN: 9789811967795

E.2 INTERNAL RESEARCH AND TECHNICAL REPORTS

E.2.1 Research Reports

INVESTIGATING THE EFFECTS OF ELECTRON BOUNCE-CYCLOTRON RESONANCE ON PLASMA DYNAMICS IN CAPACITIVE DISCHARGES OPERATED IN THE PRESENCE OF A WEAK TRANSVERSE MAGNETIC FIELD
SARVESHWAR SHARMA, SUDIP SENGUPTA, ABHIJIT SEN, SANKET PATIL, ALEXANDER KHRABROV and IGOR KAGANOVICH
IPR/RR-1402/2022 APRIL 2022

PLASMA FIREBALL-MEDIATED ION IMPLANTATION FOR NONVOLATILE MEMORY APPLICATION
SUDHEER, VIVEK PACHCHIGAR, BISWARUP SATPATI, SOORAJ K. P., SEBIN AUGUSTINE, SUKRITI HANS and MUKESH RANJAN
IPR/RR-1403/2022 APRIL 2022

COPPER ELECTROPLATING TECHNIQUE FOR DEVELOPMENT OF HTS CURRENT LEADS BOTTOM JOINTS USING MgB2 WIRES
NITIN BAIRAGI, D. SONARA, H. NIMAVAT, V. L. TANNA, U. PRASAD and D. RAJU
IPR/RR-1404/2022 APRIL 2022

A METHODOLOGY FOR QUANTIFICATION OF MATERIAL DAMAGE FROM TRANSMUTATIONS IN FUSION MATERIALS USING APPROPRIATE MODELS AND TOOLS
AKASH GARG and P. V. SUBHASH
IPR/RR-1405/2022 APRIL 2022

COMPARATIVE STUDY OF REFRACTIVE OPTICS BASED ENDOSCOPE AND WOUND IMAGING FIBER BUNDLE
SURAJ KUMAR GUPTA, VISHNU K. CHAUDHARI and MANOJ KUMAR
IPR/RR-1406/2022 APRIL 2022

EQUILIBRIUM RECONSTRUCTION OF PLASMA DISCHARGE IN THE ADITYA TOKAMAK
DEEPTI SHARMA, D. RAJU, SAMEER KUMAR, R. SRINIVASAN, MANOJ KUMAR, JOYDEEP GHOSH, R. L. TANNA and ADITYA-U TOKAMAK TEAM
IPR/RR-1407/2022 APRIL 2022

PARAMETER-SPACE FOR A ST-REACTOR ROADMAP
S. P. DESHPANDE and P. N. MAYA
IPR/RR-1408/2022 MAY 2022

ELECTROSTATIC SIMULATION MODEL OF DIELECTRIC BARRIER DISCHARGE PLASMA ACTUATORS FOR FLOW CONTROL APPLICATIONS
SHAHRUKH BAREJIA, JYOTI AGARWAL, R. SRINIVASAN and S. JAKHAR
IPR/RR-1409/2022 MAY 2022

DRIVEN NONLINEAR STRUCTURES IN FLOWING DUSTY PLASMAS
PINTU BANDYOPADHYAY and ABHIJIT SEN
IPR/RR-1410/2022 MAY 2022

SYNTHESIS AND PROCESS OPTIMISATION OF HMDS-MODIFIED SILICA NANOPOWDER SPRAY COATING FOR OIL-WATER SEPARATION
JANKI SHAH, VIVEK PACHCHIGAR and MUKESH RANJAN
IPR/RR-1411/2022 JUNE 2022

INITIAL RESULTS FROM TIME-RESOLVED LaBr BASED HARD X-RAY SPECTROMETER FOR ADITYA-U TOKAMAK
S. PUROHIT, M. K. GUPTA, M. B. CHOWDHURI, I. MANSURI, M. BHANDARKAR, B. K. SHUKLA, K. SHAH, R. MANCHANDA, U. C. NAGORA, S. K. PATHAK, K. A. JADEJA, R. L. TANNA, J. GHOSH and ADITYA TEAM
IPR/RR-1412/2022 JUNE 2022

DEPOSITED LAYER SUBSTRATE (DELAS) - A MODULE FOR RADIATION MEASUREMENT
SHWETANG N. PANDYA, SANTOSH P. PANDYA, P. A. RAYJADA and J. GOVINDARAJAN
IPR/RR-1413/2022 JUNE 2022

CFD ANALYSIS OF PREHEATING STAGE OF THE PLASMA PROCESSING CHAMBER AND COMPARISON OF RESULTS WITH THE EXPERIMENTAL DATA
HARDIK MISTRY, KEYUR PANCHOLI, SUDHIR NEMA, C. P. KAUSHIK and SHASHANK CHATURVEDI
IPR/RR-1414/2022 JUNE 2022

COUPLING OF "COLD" ELECTRON PLASMA WAVE VIA STATIONARY ION INHOMOGENEITY TO THE PLASMA BULK
SANJEEV KUMAR PANDEY, JAGANNATH MAHAPATRA and RAJARAMAN GANESH
IPR/RR-1415/2022 JUNE 2022

DESIGN OF SEMI-AUTOMATIC UHV COMPATIBLE ROTATING FILTER MECHANISM FOR SOFT-X-RAY DIAGNOSTIC OF ADITYA U
SUDHIR TRIPATHI, ASHA ADHIYA, NARENDRA N. KADAMDHAD, SHISHIR PUROHIT, MANOJ GUPTA and MANOJ KUMAR GUPTA
IPR/RR-1416/2022 JUNE 2022

INITIAL RESULTS FROM NEAR-INFRARED SPECTROSCOPY ON ADITYA-U TOKAMAK
N. RAMAIYA, R. MANCHANDA, M. B. CHOWDHURI, N. YADAVA, R. DEY, K. A. JADEJA, K. M. PATEL, R. KUMAR, S. AICH, S. K. PATHAK, R. L. TANNA, J. GHOSH and ADITYA-U TEAM
IPR/RR-1417/2022 JUNE 2022

RE-ENTRANT PHASE SEPARATION OF A SPARSE COLLECTION OF NON-RECIPROCALLY ALIGNING SELF-PROPELLED DISKS
SOUMEN DE KARMAKAR and RAJARAMAN GANESH
IPR/RR-1418/2022 JUNE 2022

FIRST RESULTS OF FAST VISIBLE IMAGING

DIAGNOSTIC IN ADITYA-U TOKAMAK
DEVILAL KUMAWAT, KUMUDNI TAHILIANI, SURESH I., S. K. PATHAK, SAMEER KUMAR, D. RAJU, R. L. TANNA, JOYDEEP GHOSH, UMESH NAGORA, MANOJ K. GUPTA, ROHIT KUMAR, KUMAR PALSINH JADEJA, SUMAN AICH and ADITYA-U TEAM
IPR/RR-1419/2022 JUNE 2022

MODULATIONAL INSTABILITY OF A YUKAWA FLUID EXCITATION UNDER THE QUASI-LOCALIZATION CHARGED APPROXIMATION (QLCA) FRAMEWORK
SANDIP DALUI, PRINCE KUMAR and DEVENDRA SHARMA
IPR/RR-1420/2022 JULY 2022

QUANTIFICATION OF MOLECULAR CONTRIBUTION IN PARTICLE INFLUX ESTIMATION USING S/XB CALCULATIONS OF Hα EMISSION IN TOKAMAKS
RITU DEY, NANDINI YADAVA, M. B. CHOWDHURI, S. PATEL, NILAM RAMAIYA, R. MANCHANDA, R. L. TANNA and JOYDEEP GHOSH
IPR/RR-1421/2022 JULY 2022

DESIGN, DEVELOPMENT AND ANALYSIS OF 1 TO 4, ANTI-PHASE IN-LINE RF POWER SPLITTER FOR LOW-FREQUENCY ISM BAND APPLICATIONS
CHIRAG SENJALIYA and SHANTANU KUMAR KARKARI
IPR/RR-1422/2022 JULY 2022

CHARACTERIZING A Ka-BAND FMCW REFLECTOMETER
JANMEJAY UMESHBHAI BUCH and SURYA KUMAR PATHAK
IPR/RR-1423/2022 JULY 2022

HEAT TRANSFER AND FLUID FLOW INVESTIGATION OF PEBBLE BED FOR FUSION BLANKET
CHIRAG SEDANI, PARITOSH CHAUDHURI and MANOJ KUMAR GUPTA
IPR/RR-1424/2022 JULY 2022

ION-DRIVEN DESTABILIZATION OF A TOROIDAL ELECTRON CLOUD -A 3D3VPIC SIMULATION
S. KHAMARU, R. GANESH and M. SENGUPTA
IPR/RR-1425/2022 JULY 2022

MEASUREMENT OF ION BEAM PROFILES USING PARALLEL WIRES AND FARADAY CUP ARRAY
BHARAT SINGH RAWAT, S. K. SHARMA, B. CHOKSI, V. PRAHLAD and U. K. BARUAH
IPR/RR-1426/2022 JULY 2022

SCALING OF MAGNETIC RECONNECTION PARAMETERS WITH AND WITHOUT IN-PLANE SHEAR FLOW IN THE MAGNETIC ISLAND COALESCENCE PROBLEM
JAGANNATH MAHAPATRA, RAJARAMAN GANESH and ABHIJIT SEN
IPR/RR-1427/2022 JULY 2022

PRELIMINARY EXPERIMENTAL STUDIES OF THE PROPOSED HIGH POWER RF ANTENNA TO ASSIST GLOW DISCHARGE CLEANING OF SST-1 AT LOW PRESSURE
M. A. ANSARI, UTTAM KUMAR GOSWAMI, DHARMENDRA RATHI, YUVAKIRAN DEVARAJ PARAVASTU, SIJU GEROGE, KALPESH R. DHANANI, PROMOD K. SHARMA, DANIEL RAJU and RAJ SINGH
IPR/RR-1428/2022 JULY 2022

TOROIDAL FIELD COIL FOR AN ELECTRON PLASMA EXPERIMENT: SMARTEX-C
LAVKESH LACHHVANI, AMARDAS

ALLI, PROSENJIT SANTRA, VINOD D. KAILA, KANUBHAI RATHOD, NIKHIL MOHURLE, JAYESH GANDHI, VIJAY PATEL, YOGESH GOVIND YEOLE, SAMBARAN PAHARI, BHARAT DOSHI and PRABAL K. CHATTOPADHYAY
IPR/RR-1429/2022 JULY 2022

ON THE EXCITATION OF ION ACOUSTIC SOLITON IN QUIESCENT PLASMA CONFINED BY MULTI-POLE LINE CUSP MAGNETIC FIELD
ZUBIN SHAIKH, A. D. PATEL, MEENAKSHEE SHARMA, H. H. JOSHI and N. RAMASUBRAMANIAN
IPR/RR-1430/2022 JULY 2022

TRANSITION OF A 2-D CRYSTAL TO A NONEQUILIBRIUM TWO-PHASE COEXISTENCE
SWARNIMA SINGH, P. BANDYOPADHYAY, KRISHAN KUMAR, M. G. HARIPRASAD, S. ARUMUGAM and A. SEN
IPR/RR-1431/2022 AUGUST 2022

LEAKY MODE RADIATION PROPERTIES OF DIELECTRIC LOADED HELIX
AJAY KUMAR PANDEY and SURYA KUMAR PATHAK
IPR/RR-1432/2022 AUGUST 2022

ROLE OF ION BEAM PARAMETERS IN FORMATION OF FACETED RIDGES ON SODA-LIME GLASS FOR WETTABILITY TUNING
SUKRITI HANS, BASANTA KUMAR PARIDA, SEBIN AUGUSTINE, VIVEK PACHCHIGAR, SOORAJ K. P. and MUKESH RANJAN
IPR/RR-1433/2022 AUGUST 2022

PERFORMANCE EVALUATION AND TEST RESULTS OF 3.3 kA RATED HTS CURRENT LEADS AT IPR
NITIN BAIRAGI, V. L. TANNA, H. NIMAVAT, D. SONARA, R. PANCHAL, A. GARG, G. MAHESURIA, R. PATEL, D. CHRISTIAN, P. PANCHAL, G. PURVAR, U. PRASAD and D. RAJU
IPR/RR-1434/2022 AUGUST 2022

SYNTHESIS & CHARACTERIZATION OF Ti3AIC2 WITH INSITU THERMAL STABILITY EVALUATION IN VACUUM ENVIRONMENT
VYOM DESAI, AROH SRIVASTAVA, A. B. ZALA, TEJAS PAREKH, SUROJIT GUPTA and N. I. JAMNAPARA
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CONTINUOUS PRODUCTION FOR LARGE QUANTITY PLASMA ACTIVATED WATER USING MULTIPLE PLASMA DEVICE SETUP
VIKAS RATHORE, CHIRAYU PATIL and SUDHIR KUMAR NEMA
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ARGON IMPURITY TRANSPORT IN OHMIC DISCHARGES OF ADITYA-U
K. SHAH, S. PATEL, M. B. CHOWDHURI, K. A. JADEJA, G. SHUKLA, T. MACWAN, A. KUMAR, S. DOLUI, K. SINGH, R. L. TANNA, K. M. PATEL, R. DEY, R. MANCHANDA, N. RAMAIYA, R. KUMAR, S. AICH, N. YADAVA, S. PUROHIT, M. K. GUPTA, U. C. NAGORA, S. K. PATHAK, P. K. ATREY, K. B. K. MAYYA and J. GHOSH
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THE ROLE OF PLASMA-ACTIVATED WATER ON THE GROWTH OF FRESHWATER ALGAE CHLORELLA PYRENOIDOSA AND CHLORELLA SOROKINIANA
VIKAS RATHORE and SUDHIR KUMAR NEMA

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REVISITING INDUCTION DYNAMO IN 3-DIMENSIONAL MAGNETOHYDRODYNAMIC PLASMAS: DYNAMO TRANSITION FROM NON-HELICAL TO HELICAL FLOWS
SHISHIR BISWAS and RAJARAMAN GANESH
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APPLICATION OF SIMILARITY THEORY TO PREDICTOPERATIONALCHARACTERISTICS OF A DC PLASMA TORCH UNDER LOW PRESSURE CONDITION
RAM KRUSHNA MOHANTA, DEVILAL KUMAWAT, G. RAVI and KUMUDNI TAHILIANI
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SELECTIVE GENERATION OF REACTIVE OXYGEN SPECIES IN PLASMA ACTIVATED WATER USING CO2 PLASMA
VIKAS RATHORE and SUDHIR KUMAR NEMA
IPR/RR-1441/2022 SEPTEMBER, 2022

NUMERICAL STUDY OF DBD PLASMA BASED INLINE TEXTILE TREATMENT SYSTEM
JYOTI AGARWAL, SHAHRUKH BAREJIA, R. SRINIVASAN, NISHA CHANDWANI, VISHAL JAIN, S. C. JAKHAR, MANIKA SHARMA and S. K. NEMA
IPR/RR-1442/2022 SEPTEMBER, 2022

ELECTROSTATIC ANALYSIS OF SST-1 PF-3 MAGNET VACUUM BARRIER AND ITS VOLTAGE BREAKDOWN ANALYSIS
JYOTI AGARWAL, DEVEN KUMAR H. KANABAR, SHAHRUKH BAREJIA, SWATI ROY, R. SRINIVASAN, UPENDRA PRASAD and RAJU DANIEL
IPR/RR-1443/2022 SEPTEMBER 2022

A SIMPLE BEAM SWITCHING CYLINDRICAL DIELECTRIC RESONATOR ANTENNA USING HELIX
AJAY KUMAR PANDEY and SURYA KUMAR PATHAK
IPR/RR-1444/2022 SEPTEMBER 2022

DESIGN AND SIMULATION OF FREQUENCY SELECTIVE SURFACE (FSS) NOTCH FILTER FOR MICHELSON INTERFEROMETER DIAGNOSTIC
JAINAM BELANI, ABHISHEK SINHA and SURYA K. PATHAK
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TRAPPING OF WAVES IN A FLOWING DUSTY PLASMA
KRISHAN KUMAR, P. BANDYOPADHYAY, SWARNIMA SINGH and A. SEN
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COLLECTIVE BEHAVIOR OF SOFT SELF-PROPELLED DISKS WITH ROTATIONAL INERTIA
SOUMEN DE KARMAKAR, ANSHIKA CHUGH, RAJARAMAN GANESH
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GYROKINETIC SIMULATIONS OF ELECTROSTATIC MICROTURBULENCE IN ADITYA-U TOKAMAK
TAJINDER SINGH, DEEPTI SHARMA, TANMAY MACWAN, SARVESHWAR SHARMA, JOYDEEP GHOSH, ABHIJIT SEN, ZHIHONG LIN and ANIMESH KULEY
IPR/RR-1448/2022 SEPTEMBER 2022

DYES DEGRADATION USING ATMOSPHERIC PRESSURE DIELECTRIC BARRIER DISCHARGE PENCIL PLASMA JET

VIKAS RATHORE, AKANKSHA PANDEY, SHRUTI PATEL, HEMAN DAVE and SUDHIR KUMAR NEMA
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DESIGN, FABRICATION AND TESTING OF FORCE FLOW COOLED HIGH-TEMPERATURE SUPERCONDUCTING CABLE
UPENDRA PRASAD, PIYUSH RAJ, MAHESH GHATE, DEVEN KANABAR, NAYAN SOLANKI, UMESH PAL, ANEES BANO, ARUN PANCHAL, DHAVAL BHAVSAR and MSD
IPR/RR-1450/2022 NOVEMBER 2022

RECONFIGURABLE PLASMA ANTENNA ARRAY FOR BEAMSTEERING APPLICATIONAT S-BAND
MANISHA JHA, NISHA PANGHAL, RAJESH KUMAR and S. K. PATHAK
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COMPARATIVE WETTABILITY STUDY OF BULK PTFE AND PVD-GROWN PTFE THIN FILM AFTER LOW ENERGY ION IRRADIATION
VIVEK PACHCHIGAR, BASANTA KUMAR PARIDA, SEBIN AUGUSTINE, SUKRITI HANS, MAHESH SAINI, SOORAJ K. P. and MUKESH RANJAN
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EFFECT OF CONVECTIVE TRANSPORT IN EDGE/SOL PLASMAS OF ADITYA-U TOKAMAK
RITU DEY, JOYDEEP GHOSH, TANMAY M. MACWAN, KAUSHLENDER SINGH, M. B. CHOWDHURI, H. RAJ, R. L. TANNA, DEEPTI SHARMA and T. D. ROGNLIEN
IPR/RR-1453/2022 NOVEMBER 2022

INVESTIGATION OF THERMAL MIXING MECHANISM IN T-JUNCTION FOR FUSION TOKAMAK APPLICATION
SANDEEP RIMZA, PARITOSH CHAUDHURI, BRIJESH KUMAR YADAV and TEJENDRA PATEL
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KELVIN-HELMHOLTZ INSTABILITY IN A COMPRESSIBLE DUST FLUID FLOW
KRISHAN KUMAR, P. BANDYOPADHYAY, SWARNIMA SINGH, VIKRAM S. DHARODI and A. SEN
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RF PLASMA DISCHARGE USING SPIRAL ANTENNA IN MULTI-DIPOLE LINE CUSP MAGNETIC FIELD
M.A. ANSARI, AMIT D. PATEL, A. DAS ALLI, PRABAL K. CHATTOPADHYAY, N. RAMASUBRAMANIAN, DANIEL RAJU and RAJ SINGH
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GYROKINETIC SIMULATION OF MULTI-SCALE ION TEMPERATURE GRADIENT INSTABILITIES IN THE ADITYA-U TOKAMAK
AMIT K. SINGH, J. MAHAPATRA, J. CHOWDHURY, D. AGGARWAL, T. HAYWARD-SCHNEIDER, R. GANESH, E. LANTI and L. VILLARD
IPR/RR-1457/2022 NOVEMBER 2022

SOURCE PERFORMANCE OPTIMIZATION IN CESIATED MODE IN ROBIN
K. PANDYA, M. J. SINGH, M. BHUYAN, M. BANDYOPADHYAY, H. TYAGI, V. MAHESH, A. GAHLAUT, K. PATEL, R. K. YADAV, S. SHAH, B. PRAJAPATI, H. MISTRI and A. CHAKRABORTY
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INFLUENCE OF γ'N AND ε'N PHASES

ON THE PROPERTIES OF AISI 304L AFTER LOW-TEMPERATURE PLASMA NITROCARBURIZING
JEET VIJAY SAH, PRAVIN KUMARI DWIVEDI, SUBROTO MUKHERJEE, GHANSHYAM JHALA and ALPHONSA JOSEPH
IPR/RR-1459/2022 DECEMBER 2022

FABRICATION ASPECTS AND PERFORMANCE CHARACTERIZATION OF SANDWICH CONFIGURATION FLOW CHANNEL INSERTS FOR LIQUID METAL APPLICATIONS UP TO 600°C
ABHISHEK SARASWAT, RAJENDRAPRASAD BHATTACHARYAY, PARITOSH CHAUDHURI and SATEESH GEDUPUDI
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OFF-TARGET FLOWS AND SHOULDER FORMATION IN 3D SIMULATIONS OF INBOARD LIMITED SCRAPE-OFF-LAYER PLASMA TRANSPORT OF ADITYA-U TOKAMAK
ARZOO MALWAL and DEVENDRA SHARMA
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PENICILLIN ANTIBIOTIC (AMPICILLIN AND CLOXACILLIN) DEGRADATION USING NON-THERMAL PENCIL PLASMA JET
VIKAS RATHORE, AKANKSHA PANDEY, SHRUTI PATEL, JIGNASA SAVJANI, SHITAL BUTANI, HEMAN DAVE and SUDHIR KUMAR NEMA
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SPATIAL MAPPING OF LOW PRESSURE CLUSTER JETS USING RAYLEIGH SCATTERING
MILAAN PATEL, GEETHIKA B. R., JINTO THOMAS and HEM JOSHI
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NANOFLUIDS: CRITICAL ISSUES AND ECONOMIC PERSPECTIVE
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IMPACT OF EDGE BIASING ON THE CROSS-FIELD TRANSPORT AND POWER SPECTRA
VIJAY SHANKAR, N. BISAI, SHRISH RAJ and A. SEN
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DESIGN AND ANALYSIS OF A 170 GHz ANTENNA FOR MILLIMETER-WAVE APPLICATIONS
SHEETAL PUNIA, SUMAN DANANI and HITESH B. PANDYA
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STUDY THE EFFECT OF ELECTRODE MATERIAL, ITS SURFACE, AND DIELECTRIC MATERIAL ON
PLASMA AND PROPERTIES OF PLASMA-ACTIVATED WATER
VIKAS RATHORE and SUDHIR KUMAR NEMA
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TOWARDS THE REALIZATION OF AN ALTERNATIVE PATHWAY FOR EFFICIENT PRODUCTION OF
HYDROGEN THROUGH PLASMA ELECTROLYSIS
AMREEN A. HUSSAIN, RAMKRISHNA RANE, AKSHAY VAID, ALPHONSA J. PALAKEL and GHYANSHYAM JHALA
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CFD ANALYSIS OF WATER COOLED GATE VALVE ASSEMBLY FOR SAFE HANDLING

OF BIO-MEDICAL WASTE INSIDE WASTE FEEDING LINES OF PLASMA PYROLYSIS SYSTEM
DEEPAK SHARMA, ATIKKUMAR MISTRY, PARITOSH CHAUDHURI and S. K. NEMA
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STUDY OF THERMAL PERFORMANCE OF UPGRADED PRIMARY CHAMBER OF PLASMA PYROLYSIS SYSTEM USING CFD ANALYSIS
DEEPAK SHARMA, ATIKKUMAR MISTRY, A. SANGHARIYAT, C. PATIL, P. CHAUDHURI and S. K. NEMA
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ION ACOUSTIC SOLITON IN A TWO ELECTRON TEMPERATURE/SPECIES QUIESCENTPLASMA CONFINED BY MULTI-POLE LINE CUSP MAGNETIC FIELD
ZUBIN SHAIKH, A. D. PATEL, P.K. CHATTOPADHYAY, JOYDEEP GHOSH, H.H. JOSHI and N. RAMASUBRAMANIAN
IPR/RR-1471/2022 DECEMBER 2022

REAL TIME MEASUREMENT OF AC AND DC ELECTRON TEMPERATURE USING COUPLED CENTER TAPPED EMISSIVE AND LANGMUIR PROBE (CCTELP)
A.K. SANYASI, L. M. AWASTHI, P. K. SRIVASTAVA, AYAN ADHIKARI and R. SUGANDHI
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REMOVAL OF AN ANOMALY IN EDGE ION TEMPERATURE ESTIMATION USING SPECTROSCOPY IN ADITYA-U TOKAMAK
NANDINI YADAVA, J. GHOSH, M. B. CHOWDHURI, ANKUR PANDYA, S. PATEL, RITU DEY, SRIPATHI PUNCHITHAYA K., R. MANCHANDA, NILAM RAMAIYA, K. A. JADEJA, R. L. TANNA, S. K. PATHAK and ADITYA-U TEAM
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LASER INDUCED BREAKDOWN SPECTROSCOPY (LIBS) FROM PHENOMENOLOGICAL ASPECTS TO APPLICATION FIELD: A SHORT REVIEW
JINTO THOMAS and HEM CHANDRA JOSHI
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STUDIES OF PHYSIO-CHEMICAL CHANGES OF DIELECTRIC BARRIER DISCHARGE PLASMA TREATED ARAMID FIBERS
SADAF JETHVA, FALGUNI BHABHOR, CHIRAYU PATIL, VYOM DESAI, ARUNSINH ZALA, NISHACHANDWANI, BALASUBRA-MANIAN C. and N. I. JAMNAPARA
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GAP PLASMON MODE COUPLING OF ALL-SPUTTERING GROWN SILVER NANOPARTICLES AND ALUMINIUM THIN FILMS FOR MANIFOLD IMPROVEMENT IN THE NEAR-FIELD AND SERS EFFICIENCY
MAHESH SAINI, VIVEK PACHCHIGAR, SEBIN AUGUSTINE, UMESH KUMAR GAUR, K. P. SOORAJ and MUKESH RANJAN
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LARGE VOLUME PLASMA DEVICE-UPGRADE: A VERSATILE PLASMA SYSTEM FOR ELECTRON EMITTER, BEAM AND WAVE BASED DIAGNOSTICS
A. K. SANYASI, P. K. SRIVASTAVA, AYAN ADHIKARI, L. M. AWASTHI and R. SUGANDHI
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DEVELOPMENT OF A FAST SOLENOID VALVE ASSISTED MECHANICAL LAUNCHER FOR CRYOGENIC PELLETS

J. S. MISHRA, P. PANCHAL, S. MUKHERJEE, V. GUPTA, H. S. AGRAVAT, P. NAYAK and R. GANGRADEY
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ARGON, NEON, AND NITROGEN IMPURITY TRANSPORT IN THE EDGE AND SOL REGIONS OF A TOKAMAK
SHRISH RAJ, N. BISAI, VIJAY SHANKAR and A. SEN
IPR/RR-1479/2023 JANUARY 2023

ENGINEERING ANALYSIS OF PROTOTYPE CENTER STACK STRUCTURE FOR SPHERICAL TOKAMAK
RANJITH KUMAR SANTHARAM, ADITYA KUMAR VERMA, PRASADA RAO PEDADA, SHIJU SAM, YELLAMRAJU S. S. SRINIVAS and RAJENDRA KUMAR ELLAPPAN
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CONFINEMENT-INDUCED DYNAMICAL STRUCTURAL REARRANGEMENT IN QUASI-2D DUSTY PLASMA
SWARNIMA SINGH, P. BANDYOPADHYAY, KRISHAN KUMAR and A. SEN
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FLUX AND ENERGY ASYMMETRY IN A LOW PRESSURE CAPACITIVELY COUPLED PLASMA DISCHARGE EXCITED BY SAWTOOTH-LIKE WAVEFORM – A HARMONIC STUDY
SARVESHWAR SHARMA, NISHANT SIRSE and MILES M. TURNER
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DEVELOPMENT OF LAB SCALE CONDUCTION COOLED HTS MAGNETS
PIYUSH RAJ, ANEES BANO, ARUN PANCHAL, PANKAJ VARMORA, DEVEN KANABAR, BHADRESH PARGHI and UPENDRA PRASAD
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3D COMPUTATIONAL FLUID DYNAMICS ANALYSIS OF PINI ION SOURCE BACK PLATE UNDER HIGH HEAT FLUX CONDITION
TEJENDRA PATEL, MUKTI RANJAN JANA and UJJWAL BARUAH
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O-MODE REFLECTOMETRY ON ADITYA-U
J. J. U. BUCH, S. K. PATHAK, K. M. PATEL and ADITYA-U TEAM
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WHISTLER HEAT-FLUX INSTABILITY GOVERNED INTERACTION OF ANISOTROPIC BEAM ELECTRONS IN ELECTROMAGNETIC VLASOV SIMULATIONS
ANJAN PAUL and DEVENDRA SHARMA
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OXIDE-BASED SYNAPTIC EMULATOR USING PLASMA FIREBALL
SUDHEER, VIVEK PACHCHIGAR, RUPAM MANDAL, SOORAJ K. P., BISWARUP SATPATI, TAPOBRATA SOM and MUKESH RANJAN
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NEUTRONIC SIMULATION OF MEDICAL RADIOISOTOPE 99Mo AND 177Lu PRODUCTION IN IPR 14
MeV NEUTRON GENERATOR FACILITY
H. L. SWAMI, A. SAXENA, S. VALA, M. ABHANGI, RATNESH KUMAR and RAJESH KUMAR
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INVESTIGATION OF TEMPORAL EVOLUTION OF HARD X-RAY SPECTRUM FROM NEON-SEEDED

PLASMA OF ADITYA-U TOKAMAK
SHISHIR PUROHIT, MANOJ KUMAR GUPTA, MALAY BIKAS CHOWDHURI, UMESH NAGORA, YASHIKA TAUNK, ABHISHEK KUMAR, KAJALGARG, SURYA KUMAR PATHAK, KUMARPALJADEJA, ROHIT KUMAR, KUMUDNI TAHILIANI, SAMEER KUMAR, KAUSHAL PATEL, RAKESH TANNA, SUPRIYA ANIL NAIR, JOYDEEP GHOSH and ADITYA-U TEAM
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INTERACTION OF A PRECURSOR SOLITON WITH WAKE STRUCTURE IN A FLOWING DUSTY PLASMA
KRISHAN KUMAR, P. BANDYOPADHYAY, SWARNIMA SINGH and A. SEN
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EXPERIMENTAL MEASUREMENT OF P-Q CHARACTERISTICS OF AN ELECTRO-MAGNETIC PUMP FOR HEAVYLIQUID METALS
S. SAHU, H. TAILOR, A. PRAJAPATI, S. GUPTA, S. VERMA and R. BHATTACHARYAY
IPR/RR-1491/2023 FEBRUARY 2023

PLASMA SOURCES AND DIAGNOSTIC SOLUTIONS FOR NEGATIVE ION RESEARCH
SHANTANU KUMAR KARKARI
IPR/RR-1492/2023 FEBRUARY 2023

RUNAWAY ELECTRON MITIGATION WITH PULSED LOCALIZED VERTICAL MAGNETIC FIELD PERTURBATION IN ADITYA TOKAMAK
R. L. TANNA, S. PATEL, J. GHOSH, CHETNA CHAUHAN, A. AMARDAS, P. K. CHATTOPADHYAY, K. A. JADEJA,Y. S. JOISA, U. C. NAGORA, P. K. ATREY, M. B. CHOWDHURI, R. MANCHANDA, Y. C. SAXENA and THE ADITYA TEAM
IPR/RR-1493/2023 FEBRUARY 2023

DEVELOPMENT OF A NOVEL APPARATUS TO MEASURE EMISSIVITY OF HIGH ROUGHNESS MATERIALS AT 82 K
AVIJIT DEWASI, RANJANA GANGRADEY, SAMIRAN SHANTI MUKHERJEE, VISHAL GUPTA, ROHAN DUTTA, ABHINAV B. DESAI, JYOTI S. MISHRA, PARESH PANCHAL, PRATIK A. NAYAK and HEMANG S. AGRAVAT
IPR/RR-1494/2023 FEBRUARY 2023

EFFECT OF ANNEALING GAS ON GRAIN GROWTH OF CZTS LAYER: STUDY ON DEVICE EFFICIENCY
SAGAR AGRAWAL, C. BALASUBRAMANIAN and SUBROTO MUKHERJEE
IPR/RR-1495/2023 FEBRUARY 2023

SIMPLE TIGHT ASPECT RATIO MACHINE ASSEMBLY TO STUDY ECR PRODUCE MAGNETIZED TOROIDAL PLASMA
T. RAM, JAGABANDHU KUMAR, P. K. SHARMA, RAJU DANIEL, P. R. PARMAR, K. K. AMBULKAR, A. L. THAKUR, A. KUNDU, V. D. RAULJI, B. ARAMBHADIYA, ABHIJEET KUMAR, PRAVEENLAL EDAPPALA, PRAMILA, H. D. MANDLIYA, URMIL THAKER and SUPRIYA A. NAIR
IPR/RR-1496/2023 FEBRUARY 2023

METHOTREXATE DEGRADATION IN ARTIFICIAL WASTEWATER USING NON-THERMAL PENCIL PLASMA JET
VIKAS RATHORE, SHRUTI PATEL, AKANKSHA PANDEY, JIGNASA SAVJANI, SHITAL BUTANI, HEMAN DAVE and SUDHIR KUMAR NEMA
IPR/RR-1497/2023 FEBRUARY 2023

EXTENDED PASCHEN MODEL FOR

ESTIMATING BREAKDOWN VOLTAGE OF BINARY AND TERNARY GAS MIXTURES
SHAHRUKH BAREJIA, S. JAKHAR, JYOTI AGARWAL, MANIKA SHARMA and R. SRINIVASAN
IPR/RR-1498/2023 FEBRUARY 2023

SELF-ORGANIZED ORDERED Ag NANOPARTICLES WERE GROWN ON LOW AMPLITUDE RIPPLES OF SODA LIME GLASS SUBSTRATE TO DETECT METANIL YELLOW IN TURMERIC SOLUTION
SEBINAUGUSTINE, SOORAJ K. P., MAHESH SAINI, SUKRITI HANS, BASANTA KUMAR PARIDA, VIVEK PACHCHIGAR and MUKESH RANJAN
IPR/RR-1499/2023 FEBRUARY 2023

STUDY OF OHMIC BREAKDOWN PHASE OF ADITYA TOKAMAK
S. PATEL, R. L. TANNA, J. GHOSH, P. K. CHATTOPADHYAY, M. B. CHOWDHURI, R. MANCHANDA, N. RAMAIYA, K. A. JADEJA, K. M. PATEL, M. N. MAKWANA, K. S. SHAH, U. C. NAGORA, K. B. K. MAYYA and ADITYA TEAM
IPR/RR-1500/2023 FEBRUARY 2023

LASER CLUSTER INTERACTION IN EXTERNAL MAGNETIC FIELD: EMERGENCE OF NEARLYMONO-ENERGETIC WEAKLY RELATIVISTIC ELECTRON BEAM
KALYANI SWAIN, S. S. MAHALIK and M. KUNDU
IPR/RR-1501/2023 FEBRUARY 2023

INVESTIGATIONS OF MAGNETIZED PLASMA EVOLUTION IN LVPD-UPGRADE HAVING UNIFORM SOURCE AND SPATIALLY VARIABLE TRANSPORT
AYAN ADHIKARI, A. K. SANYASI, L. M. AWASTHI,P. K. SRIVASTAVA, ANSHU VERMA, MAINAK BANDOPADHYAY and RITESH SUGANDHI
IPR/RR-1502/2023 FEBRUARY 2023

INFLUENCE OF CHAMBER PRESSURE ON THE OUTPUTCHARACTERISTICS OF A LOW-PRESSURE DC PLASMA SPRAYTORCHES: AN EXPERIMENTAL INVESTIGATION
RAM KRUSHNA MOHANTA, DEVILAL KUMAWAT, G. RAVI and KUMUDNI TAHILIAN
IPR/RR-1503/2023 MARCH 2023

PREPARATION, STABILIZATION, AND THERMAL CHARACTERISATION OF CUO/ WATER NANOFLUIDS APPLICABLE TO DOMESTIC SOLAR WATER HEATER
DRASHTI SHAH, SAYANTAN MUKHERJEE, AROH SHRIVASTAVA, PARITOSH CHAUDHARI, RONAK PATEL and SANDEEP RIMZA
IPR/RR-1504/2023 MARCH 2023

EFFECT OF FLOW SHEAR ON THE ONSET OF DYNAMOS
SHISHIR BISWAS and RAJARAMAN GANESH
IPR/RR-1505/2023 MARCH 2023

SIMULATION AND IMPLEMENTATION OF A 350kV, 50mA HIGH VOLTAGE DC GENERATOR FOR PARTICLE ACCELERATOR APPLICATIONS
AMAL S., ASHOK D. MANKANI, POOJA JOSHI, ARITRA CHAKROBORTY, PAUL D CHRISTIAN,
KUMAR SAURABH and UJJWAL K. BARUAH
IPR/RR-1506/2023 MARCH 2023

MAGNETIZED MULTICOMPONENT PLASMAS SHEATH CHARACTERISTICS WITH THREE ISOTHERMAL ION SPECIES

AKSHAYA KUMAR SHAW, AMULYA KUMAR SANYASI and DEVENDRA SHARMA
IPR/RR-1507/2023 MARCH 2023

EXPERIMENTAL STUDIES ON THE ROLES OF CHARGE EXCHANGE IONS AND SPACE CHARGE NEUTRALIZATION IN A RING CUSP ION SOURCE
BHARAT SINGH RAWAT, S. K. SHARMA, V. PRAHLAD, B. CHOKSI and U. K. BARUAH
IPR/RR-1508/2023 MARCH 2023

STUDY OF MAGNETIZED PLASMA SHEATH PROPERTIES IN PRESENCE OF TWO GROUP ELECTRONS AND TWO ISOTHERMAL ION SPECIES
AKSHAYA KUMAR SHAW, DEVENDRA SHARMA and SATYANANDA KAR
IPR/RR-1509/2023 MARCH 2023

ENHANCING THE PROPERTIES OF PLASMA ACTIVATED WATER USING AN AIR BUBBLE DIFFUSER
VIKAS RATHORE, NIRAV I. JAMNAPARA and SUDHIR KUMAR NEMA
IPR/RR-1510/2023 MARCH 2023

E.2.2 Technical Reports

Measurement of Thermal Strain in the Structural Material using a Strain Gauge and its Comparisons using the 2D-DIC Techniques
MAULIK PANCHAL, ABHISHEK SARASWAT, VRUSHABH LAMBADE, HARSH PATEL, KEDAR BHOPE, MAYUR MEHTA, SAMIR S. KHIRWADKAR and PARITOSH CHAUDHURI
IPR/TR-670/2022 (April 2022)

Development of HTS Tape Double Pancake Winding Machine
HEMANG AGRAVAT, PIYUSH RAJ, ARUN PANCHAL, PRATHMESH BHATT, UPENDRA PRASAD and R. SRINIVASAN
IPR/TR-671/2022 (April 2022)

Design and Development of Python Based Libraries to Access Multiple Instruments and Devices
RAMESH JOSHI, H. M. JADAV, SUNIL KUMAR and HIGH POWER ICRH SYSTEMS DIVISION
IPR/TR-672/2022 (April 2022)

Automated Plasma Probing System for Laboratory Experiments in High Vacuum Using Closed Loop Control
ROSH ROY, R. SUGANDHI, M. KUMAR and P. K. CHATTOPADHYAY
IPR/TR-673/2022 (April 2022)

Testing and Validation of Standard Bi-Metallic (SS-Al) Pipe Joints for LIGO Application
NARESH CHAND GUPTA, ANANTA KUMAR SAHU, KEDAR BHOPE, MAYUR M. MEHTA, RAJNIKANT BHATTASANA and OMKAR CHANDRATRE
IPR/TR-674/2022 (May 2022)

Standalone Software Configuration for CDS Test Rack
HITESH K. GULATI, ARNAB DASGUPTA and AMIT K. SRIVASTAVA
IPR/TR-675/2022 (May 2022)

Coaxial Tungsten Hot Plate-Based Cathode Source for Cesium Plasma Production Confined in MPD Device
A. D. PATEL, ZUBIN SHAIKH, M. SHARMA, SANTOSH P. PANDYA and N. RAMASUBRAMANIAN
IPR/TR-676/2022 (May 2022)

RF Communication with Salt Water Standing Column and Water Jet

A. SARADA SREE and RAJESH KUMAR
IPR/TR-677/2022 (May 2022)

Engineering Design Report of Prototype Center Stack
ADITYA KUMAR VERMA, RANJITH KUMAR, PRASAD RAO PEDADA, SHIJU SAM, Y. S. S. SRINIVAS and E. RAJENDRA KUMAR
IPR/TR-678/2022 (May 2022)

Finite Element Simulation for Validation of Multi-Dipole Line Cusp Magnetic Field Configuration for MPD
A. D. PATEL, A. AMARDAS and N. RAMASUBRAMANIAN
IPR/TR-679/2022 (June 2022)

Linux Based High Speed Embedded Data Acquisition System for Long Pulse Discharge in ADITYA-U Tokamak
PRAMILA GAUTAM, HITESH MANDALIYA, VISMAYSINH RAULJI and RACHANA RAJPAL
IPR/TR-680/2022 (June 2022)

Finite Element Analyses of Double Sided LIM for EML
ANANYA KUNDU, PRASAD RAO PEDADA, ANKUR JAISWAL, ARVIND KUMAR, Y. S. S. SRINIVAS, VILAS CHAUDHARI, RAMBABU SIDIBOMMA and E. RAJENDRA KUMAR
IPR/TR-681/2022 (June 2022)

Upgrade Data Acquisition Module for ICRH Transmission Line DAC System
RAMESH JOSHI, H. M. JADAV, SUNIL KUMAR and HIGH POWER ICRH SYSTEMS DIVISION
IPR/TR-682/2022 (June 2022)

Design, Development and Automation of Multi-Channel Detector Bias Voltage Electronics for Thomson Scattering Experiment
V. CHAUDHARI, PABITRA MISHRA, NEHA SINGH, JINTO THOMAS and H. C. JOSHI
IPR/TR-683/2022 (June 2022)

Characterization of Single Stage Superheterodyne Circuit for Ka-Band FMCW Reflectometry
ROHIT MATHUR, JJU. BUCH, VISHNU CHAUDHARY and S. K. PATHAK
IPR/TR-684/2022 (June 2022)

Design of Exhaust System for Tritium Handling and Recovery System of Accelerator Based 14 Mev Neutron Generator
SUDHIR TRIPATHI, MITUL ABHANGI, H. L. SWAMI, SUDHIR VALA AND MANOJ K. GUPTA
IPR/TR-685/2022 (June 2022)

Conceptual Design and Preliminary Data Analysis for Classification of Plasma Disruption Event at ADITYA-U Tokamak
RAMESH JOSHI, JOYDEEP GHOSH, NILESH KALANI, R. L. TANNA and ADITYA/ADITYA-U TEAMS
IPR/TR-686/2022 (June 2022)

Design & Automation of Heater Controller Power Supply For Heating the High Temperature Black Body Source
BHARATKUMAR ARAMBHADIYA, VISMAYSINH RAULJI, RACHANA RAJPAL, VARSHA SIJU, KARISHMA PANDYA, PRAVEENA SHUKLA and S. K. PATHAK
IPR/TR-687/2022 (June 2022)

Optimization of Layer Pattern of Regenerator for a Low-Frequency Pulse-Tube Cryocooler
ABHINAV B. DESAI, ROHAN DUTTA, HEMANG AGRAVAT, VISHAL GUPTA, SHASHI K. VERMA, AVIJIT DEWASI, SAMIRAN MUKHERJEE, JYOTI S. MISHRA,

PARESH PANCHAL, PRATIK A. NAYAK and RANJANA GANGRADEY
IPR/TR-688/2022 (June 2022)

Optimization of Ion Source Operation using the Electrical Diagnostics for Steady State Superconducting Tokamak-1 Neutral Beam Test Stand
KARISHMA QURESHI, PARESH PATEL, LAXMIKANTBANSAL,VIJAYVADHER,DIPAL THAKKAR, C. B. SUMOD, LAXMINARAYAN GUPTA and UJJWAL BARUAH
IPR/TR-689/2022 (July 2022)

Design and Development of LN2 Cooled Cryopump for Application in High Heat Flux Test Facility
S. S. MUKHERJEE, V. GUPTA, P. PANCHAL, J. S. MISHRA, P. NAYAK, J. AGARWAL, H. AGRAVAT, A. DEWASI, R. DUTTA, A. DESAI, S. K. VERMA, R. SWAMY, P. MOKARIYA, N. PATEL, T. PATEL, S. M. BELSARE, S. S. KHIRWADKAR and R. GANGRADEY
IPR/TR-690/2022 (July 2022)

Digital Signal Processing Simulation for Plasma Electron Density Measurement on FPGA
KIRAN PATEL, UMESH NAGORA, H. C. JOSHI and SURYA PATHAK
IPR/TR-691/2022 (July 2022)

Sensors Installation, Signal Conditioning Electronics and PXI Based Data Acquisition System Operation for Nb3Sn Solenoid
PANKAJ VARMORA, BHADRESH PARGHI, MONI BANAUDHA, PIYUSH RAJ, ARVIND TOMAR, MAHESH GHATE, AZAD MAKWANA, ARUN PANCHAL, DHAVAL BHAVSAR, NITISH KUMAR, ANEES BANO, ROHIT PANCHAL, DASARATH SONARA, RAKESH PATEL, HIREN NIMAVAT, GAURANG MANSURIA, CHRISTIAN DIKENS, ATUL GARG, GAURAV PURVAR, VIPUL TANNA, RAJU DANIEL and UPENDRA PRASAD
IPR/TR-692/2022 (July 2022)

Transmission Characteristics of Plasma-Based Microwave Absorbing Panel in Near and Far Field Region of Testing Antenna
N. RAJAN BABU, HIRAL B. JOSHI, AGRAJIT GAHLAUT, SAGAR SHAH, RAJESH KUMAR and ASHISH R. TANNA
IPR/TR-693/2022 (July 2022)

Design of New Target Handling System, Extension Chamber and Modifications to the Existing Target Handling System of High Heat Flux Test Facility
RAJAMANNAR SWAMY, S. S. KHIRWADKAR, NIKUNJ PATEL, VINAY MENON, KEDAR BHOPE, SUNIL BELSARE, PRAKASH MOKARIA and TUSHAR PATEL
IPR/TR-694/2022 (August 2022)

Design and Testing of 0.35/25 kV, 20 kHz Transformers for Nuclear Applications
ARITRA CHAKRABORTY, PAUL CHRISTIAN, AMAL S., SAURABH KUMAR, ANANYA KUNDU, ASHOK MANKANI and UJJWAL KUMAR BARUAH
IPR/TR-695/2022 (August 2022)

Development and Application of Vibration Diagnostics for Condition Monitoring in High Heat Flux Test Facility at IPR
KEDAR BHOPE, MAYUR MEHTA, SUNIL BELSARE, SAMIR KHIRWADKAR, VINAY MENON, RAJAMANNAR SWAMY, PRAKASH MOKARIYA, TUSHAR PATEL and NIKUNJ PATEL
IPR/TR-696/2022 (August 2022)

Phase-I Design of Data Acquisition and Control System of Large Scale Cryogenics Plant System

V. B. PATEL, A. K. SAHU, A. L. SHARMA, H. H. CHUDASMA, H. MASAND, H. J. DAVE, I. A. MANSURI, J. J. PATEL, M. K. BHANDARKAR, O. CHANDRATRE, P. GADDAM, P. SINGH, T. S. RAO, K. MAHAJAN and LCPC TEAM
IPR/TR-697/2022 (September 2022)

First MHD Experiments at IPR in LLMHD Loop
A. PATEL, S. VERMA, A. SARASWAT, P. SATYAMURTHY, S. MALHOTRA, R. BHATTACHARYAY, S. GUPTA, A. PRAJAPATI, M. KUMAR, T. S. RAO, A. MAKWANA, D. SHARMA, A. JAISWAL, D. MOHANTA, S. K. SHARMA, V. VASAVA, H. TAILOR, A. DEOGHAR, S. SAHU, U. PRASAD, A. RANJAN and S. RANJITH KUMAR
IPR/TR-698/2022 (September 2022)

Design and Analysis of Heat Exchanging Elements, Cold-End Heat Exchanger cum Flow Straighteners, and Hot-End Heat Exchanger of a Pulse Tube Cryocooler Constrained by Fluid Dynamics
ABHINAV B. DESAI, ROHAN DUTTA, HEMANG AGRAVAT, AVIJIT DEWASI, VISHAL GUPTA, SAMIRAN MUKHERJEE, JYOTIS. MISHRA, PARESH PANCHAL, PRATIK A. NAYAK and RANJANA GANGRADE
IPR/TR-699/2022 (September 2022)

Flood Modelling Simulation: A Feasibility Study Using Open Source Code
SHAILJA TIWARI, MANIKA SHARMA and SHASHANK CHATURVEDI
IPR/TR-700/2022 (September 2022)

Immersive Virtual Reality Applications to Train Operators for Emergency Preparedness
NAVEEN RASTOGI, KRISHAN KUMAR GOTEWAL, RAVI RANJAN KUMAR, MANOAH STEPHEN MANUELRAJ and JIGNESH CHAUHAN
IPR/TR-701/2022 (September 2022)

Conceptual Design of Open Source IoT Based Software Solution for Cryogenic Experiments
RAMESH JOSHI, H. M. JADAV, SUNIL KUMAR and VISHNU PATEL
IPR/TR-702/2022 (October 2022)

Concept Development and Prototyping of End Connections for Flexible Cryostat towards Testing of HTS Cables
MAHESH GHATE, NAYAN SOLANKI, VIJAY VASAVA, SURENDRASINH JADEJA, FIROZKHAN PATHAN, DEVEN KANABAR, PIYUSH RAJ, UMESH PAL, ANEES BANOO, DHAVAL BHAVSAR and UPENDRA PRASAD
IPR/TR-703/2022 (October 2022)

Development of Automated Calibration Setup for Ultra-Wide Band Microwave Source for Reflectometry Diagnostic
VISHNU CHAUDHARY, J.J.U. BUCH and S. K. PATHAK
IPR/TR-704/2022 (October 2022)

Investigating the Effect of Density Variation on Pitch Angle Scattering Events of Runaway Electrons as Observed Through Electron Cyclotron Emission Diagnostic at ADITYA-Upgrade Tokamak
VARSHA SIJU, SANTOSH P. PANDYA, S. K. PATHAK, UMESH NAGORA, JAYESH RAVAL, SHISHIR PUROHIT, ANSH PATEL, M. K. GUPTA, K. TAHILIANI, R. L. TANNA, KUMARPALSINH JADEJA, ROHIT KUMAR and J. GHOSH
IPR/TR-705/2022 (October 2022)

Conceptual Design of a Microwave Cavity Perturbation Based System for Teflon and Nylon Pellets Mass Measurement
ROHIT KUMAR SAINI, JYOTI SHANKAR MISHRA and RANJANA GANGRADEY

IPR/TR-706/2022 (October 2022)
Developing Scalable Parallel Applications using Small and Low-Cost Testbed Cluster of Single Board Computers
DEEPAK AGGARWAL, ARKAPRAVA BOKSHI and DEEP LAD
IPR/TR-707/2022 (October 2022)

Design, Fabrication, and Testing of 0.2 T High-Temperature Superconducting Solenoid Coil with Room Temperature Bore Cryostat
UPENDRA PRASAD, MAHESH GHATE, PIYUSH RAJ, DEVEN KANABAR, ANEES BANOO, ARUN PANCHAL, DHAVAL BHAVSAR, UMESH PAL, NAYAN SOLANKI, HEMANG AGRAVAT, ARVIND TOMAR, NITISH KUMAR, BHADRESH PARGHI, PANKAJ VARMORA, FIROZKHAN PATHAN, ARUN PRAKASH, SHIJU GEORGE and MSD
IPR/TR-708/2022 (October 2022)

Preliminary Design of the MHD Test Mock up with Complex Flow Configuration
A.PATEL,R.KUMAR,S.VERMA,A.PRAJAPATI, A. SARASWAT and R. BHATTACHARYAY
IPR/TR-709/2022 (November 2022)

Experience of Pumping the Vacuum Vessel of SST-1 during the Baking Cycle with Indigenously Developed Liquid Nitrogen Cooled Sorption Pump
VISHAL GUPTA, SAMIRAN S. MUKHERJEE, AVIJIT DEWASI, JYOTI SHANKAR MISHRA, PRATIK A. NAYAK, PARESH PANCHAL, VIPUL L. TANNA, YUVAKIRAN PARAVASTU, DILIP C. RAVAL, ZIAUDDIN KHAN, RAJU DANIEL, SIJU GEORGE, ATUL GARG, L. N. SRIKANTH, KALPESH R. DHANANI, ROHAN DUTTA, ABHINAV B. DESAI, HEMANG S. AGRAVAT and RANJANA GANGRADEY
IPR/TR-710/2022 (December 2022)
Wire-Burn Test Results of HVPS2 for Output Stage and HVPS1 for Driver Stage Power Supplies of 1.5MW RF Generator
BHAVESH KADIA, KIRIT PARMAR, GAJENDRA SUTHAR, HITESH DHOLA, DISHANG UPADHYAY, KISHORE MISHRA, RAGHURAJ SINGH, RAJESH TRIVEDI, N.P. SINGH, SUNIL KUMAR and IPR ICRH & ITER-INDIA POWER SUPPLY GROUPS
IPR/TR-711/2023 (January 2023)

Development of Prototype Power Supply for Ohmic Transformer System of SSST
URMIL THAKER, VAIBHAV RANJAN and SUPRIYA NAIR
IPR/TR-712/2023 (January2023)

Development of a Test Set Up for HTS Sample Characterization Using Solid Nitrogen
NITISH KUMAR, ARVIND TOMAR, ANEES BANO, PIYUSH RAJ, PANKAJ VARMORA, BHADRESH PARGHI, MONI BANAUDHA, CHIRAG DODIYA, V. L. TANNA, RAJU DANIEL and UPENDRA PRASAD
IPR/TR-713/2023 (January 2023)

Study of Capture Fraction of Water by Cryopump for LI-VISTA Test Bed Using Molflow Tool
S. AHMED, S. SUNIL and S. MUKHERJEE
IPR/TR-714/2023 (January 2023)

Development and Validation of Room Temperature Bore Cryostat for Testing of HTS Solenoid Magnet up to 55 K
MAHESH GHATE, DHAVAL BHAVSAR, HEMANG AGRAVAT, NAYAN SOLANKI, DEVEN KANABAR, PIYUSH RAJ, ANEES BANO, UMESH PAL, FIROZKHAN PATHAN, ARUN PANCHAL, ARVIND TOMAR, NITISH KUMAR, ARUN PRAKASH, SIJU GEORGE, ZIAUDDIN KHAN and UPENDRA PRASAD
IPR/TR-715/2023 (January 2023)

Optimization of Centralized LN2, GN2 Distribution for New Lab at IPR
NARESH CHAND GUPTA, VIPUL TANNA, ANANTA KUMAR SAHU, RANJANA GANGRADEY and NITIN SHAH
IPR/TR-716/2023 (January 2023)

Performance Study of ANU-400 Turbomolecular Pump
PRATIBHA JAKHMOLA, KALPESH R. DHANANI, DILIP C. RAVAL, ZIAUDDIN KHAN, SHASHANK CHATURVEDI, NAYAN B. KOLI, B. L. MEENA, J. A. BHOSALE, S. G. BOBADE, S. S. THAKUR, R. K. CHOUDHARY, LALCHAND, PRABHAT RANJAN, MUNENDRA SINGH, BRAJPAL, KANCHAN GARAIN, SAUMITRA PAL, PRADIP H. CHAVDA and A. K. WANKHEDE
IPR/TR-717/2023 (January 2023)

Implementation of SOLPS5.1 to SST-1 and ADITYA-U Tokamak
ANIL KUMAR TYAGI, M. HIMABINDU, DEEPTI SHARMA and DEVENDRA SHARMA
IPR/TR-718/2023 (January 2023)

Development of Deep Learning Models for Time Series Analysis for Predicting Future Sequence of Signals at ADITYA-U Tokamak
RAMESH JOSHI, JOYDEEP GHOSH, NILESH KALANI, R. L. TANNA and ADITYA/ADITYA-U TEAMS
IPR/TR-719/2023 (February 2023)

Design and Testing of Thermo-Electric Cooler Controller for Detection
Sub-System of Thomson Scattering Diagnostic
VISHNU CHAUDHARI, NEHA SINGH, PABITRA MISHRA and JINTO THOMAS
IPR/TR-720/2023 (February 2023)

Applied Plasma Physics Experiments in Linear (APPEL) Device and Its First Plasma Characterization for Plasma Surface Interaction Studies
Y. PATIL and S. K. KARKARI
IPR/TR-721/2023 (February 2023)

Hazard & Operability (HAZOP) Study Report of Thermic Fluid System
ANKUSH V. DEOGHAR, SHRIKANT VERMA, ABHISHEK SARASWAT, RUDREKSH PATEL, ANITA PATEL, ANKIT GANDHI and RAJENDRAPRASAD BHATTACHARYAY
IPR/TR-722/2023 (March 2023)

High Heat Flux Testing of Brazed W/CuCrZr Mono-Block in HHFTF
KEDAR BHOPE, VINAY MENON, SUNIL BELSARE, SAMIR KHIRWADKAR, RAJAMANNAR SWAMY, MAYUR MEHTA, K.P. SINGH, TUSHAR PATEL, NIKUNJ PATEL and PRAKASH MOKARIYA
IPR/TR-723/2023 (March 2023)

Periodic Hydrostatic Testing, Inspection and Certification of Helium Gas Cylinders
RAJIV SHARMA, HIREN NIMAVAT, PANKIL SHAH, KETAN PATEL, L. N. SRIKANTH and V. L. TANNA
IPR/TR-724/2023 (March 2023)

Review of Cockcroft-Walton High Voltage Low Current DC Power Supplies
URMIL THAKER and SANTOSH C. VORA
IPR/TR-725/2023 (March 2023)

Investigation of Impulse Voltage Test of Ohmic Coil System in ADITYA-U Tokamak
ROHIT KUMAR, R. L. TANNA, TANMAY MACWAN, S. AICH, HARSHITA RAJ and J. GHOSH

IPR/TR-726/2023 (March 2023)

Finite Element Analysis of Scintillator Crystal Temperature Rise for ITER HXR-Monitor due to the Radiation Flash Load Following the Activation of the Disruption Mitigation System
HARDIK MISTRY, SANTOSH P. PANDYA, BRAJ KISHORE SHUKLA, KUMUDNI TAHILIANI, SURYA KUMAR PATHAK, RICHARD O'CONNOR and TIEULENT RAPHAEL
IPR/TR-727/2023 (March 2023)

Design Report of Tin-Lithium (Sn-Li) Alloy Production Facility
SHAILESH KANPARA, ALPESH PATEL, VINAY MENON, SUNIL BELSARE, KEDAR BHOPE, ANKUSH DEOGHAR, TUSHAR PATEL, NIKUNJ PATEL and SAMIR KHIRWADKAR
IPR/TR-728/2023 (March 2023)

Electromagnetic and Structural Analysis of in-vessel Coils of SST-1
A. AMARDAS
IPR/TR-729/2023 (March 2023)

E.3 CONFERENCE PRESENTATION

APS April Meeting, New York City, USA, 11th April 2022

Computational studies of current driven instabilities in a tokamak plasma
Jervis Ritesh Mendonca, J. Ghosh, R.L. Tanna, A. Sen

National Conference on Physical Sciences-2022 (NCPS-2022), Department of Physics, Dibrugarh Hanumanbax Surajmall Kanoi College, and Manipur University, Manipur, 29-30th April 2022

Study of Ion Acoustic Waves in a single electron temperature plasma
Kishor Deka

A study on the dust dynamics in presence of energetic electron component
Rupali Paul

Production and validation of multi-electron species in a glow discharge plasma
Gunjan Sharma

DAE-BRNS Two-Day Theme Meeting on Strategic Planning for Enhancing Research Reactor Utilization (RRU-2022), Bhabha Atomic Research Centre, Mumbai, 6-7th May 2022

Evaluation of Mo-99 and Lu-177 Radioisotopes Production in 14 MeV Neutron Generator Facility
H. L. Swami

Topical Conference on High Temperature Plasma Diagnostics, University of Rochester, USA, on 16th May 2022

Deposited Layer Substrate (DeLaS) - a module for radiation measurement
Shwetang N. Pandya

High Temperature Plasma Diagnostics (HTPD-22) Conference, Rochester University, New York, on 19th May 2022

Investigating the effect of density variation on Pitch angle scattering events of Runaway electrons as observed through ECE Diagnostic at ADITYA-Upgrade tokamak
Varsha Siju

3rd URSI Atlantic / Asia-Pacific Radio Science Meeting-2022 (AT-AP-RASC 2022), Spain, 29

May - 3 June 2022

Optimization and Simulation of Helix loaded with Dielectric Dispersion Characteristics using TLBO Algorithm
Ajay Kumar Pandey

41st Meeting of the ITPA Topical Group on Diagnostics, ITER Organization, 30 May-02 June 2022

IN-DA Progress Report
Ravinder Kumar

25th International Conference on Plasma Surface Interaction in Controlled Fusion Devices (PSI-25), Korea, 13-17 June 2022

Studies on the retarded recrystallization of tungsten in CIMPLE-PSI exposed at extreme surface temperature and He+-fluence
Mayur Kakati

21st Joint Workshop on Electron Cyclotron Emission (ECE) and Electron Cyclotron Resonance Heating (ECRH), ITER France, 20-24th June 2022

Recent progress on the electron cyclotron emission diagnostics development for ITER
Saeid Houshmandyar, William L. Rowan, B. Arambhadiya, J. H. Beno, S. Danani, R. Kumar, Yong Liu, H. Mandaliya, Ouroua, S. Padadalagi, H. Pandya, G. Paraiso, S. Pish, R. Rajpal, S. Singh, Gary Taylor, V. S. Udintsev, Francois L. Waelbroeck
ECRH experiments on Tokamaks SST-1 & ADITYA-U and ECRH upgradation plan for SST-1
Braj Kishore Shukla

Fast Scan Fourier Transform Michelson Interferometer System for SST-1 Tokamak
Abhishek Sinha, Dusmanta Mohanta, Manisha Bhandarkar, Surya K Pathak, Sonam Sharma, Imran Mansuri, Pratibha Gupta

48th European Conference on Plasma Physics (EPS 2022), European Physical Society, Online, 27 June 2022 - 1 July 2022

Study of Electrode Biasing in the Edge and SOL Regions of a Tokamak
Vijay Shankar, Nirmal Bisai, Shrish Raj, Abhijit Sen

Growth of Electron Hole in 1D Vlasov Plasma And 4D Gyro And Bounce Averaged Kinetic Vlasov Simulation
Debraj Mandal, Devendra Sharma, Maxime Lesur, Alejandro Guillevic

Expanding Hydrogen plasma in diverging Magnetic fields in an ECR based Large Volume Plasma System
Shweta Sharma, D. Sahu, R. Narayanan, S. Kar, R.D. Tarey, A. Ganguli, M. Bandyopadhyay, A. Chakraborty, M.J. Singh

3rd International Conference on Paradigms of Communication, Computing and Data Sciences (PCCDS 2022), Malaviya National Institute of Technology, Jaipur, 5-7 July 2022

Conceptual Design and Preliminary Data Analysis for Classification of Plasma Disruption Event at ADITYA-U Tokamak
Rameshkumar Joshi, Joydeep Ghosh, Nilesh Kalani, R. L. Tanna, and ADITYA/ADITYA-U Teams

5th International Conference of Young Researchers on Advanced Materials, Fukuoka,

Japan, 3-6th August 2022

Influence of particle diameter and density on the trap efficiency of acoustic field
Satya Prakash Reddy Kandada

13th International Workshop on Non-Neutral Plasmas, Milano, Italy, 19-22 September 2022

Gas Puff Experiments in Electron plasma of partial torus SMARTEX-C
Lavkesh Lachhvani

National Conference on Recent Developments and Evolving Trends in Plasma Science and Technology & Pre-conference Workshop on Modelling and Simulation of Industrial Plasmas, Bharathiar University, Coimbatore, 22-24th September 2022

NF3 Plasma Based Surface Etching Process - An Extended Utilization towards Nuclear Industries
H. L. Swami

Antimicrobial, Agriculture, and Aquaculture Applications of Plasma Activated Water
Vikas Rathore

Self-Organized Ordered Nanoparticles Arrays for the SERS Applications
Sebin Augustine

Plasma Assisted Ignition and Combustion of Pulverized Coal
A. Sanghariyat

Study of the Characteristics of Plasma Discharge Current in Atmospheric Pressure Plasma and Low Pressure Plasma Using the High-Voltage Medium-Frequency Power Source
C. Patil

Effect of Oxygen Partial Pressure on Copper Thin Film Deposited by Planar Magnetron Sputtering
Infant Solomon

Deposition of Titanium Interface on Stainless Steel using Magnetron Plasma Sputtering for Adhesion Improvement of Back Contact Layer
Vishal Dhamecha

Surface Engineering and Characterization of S-Phase formed in AISI 304 Austenitic Stainless Steel by Plasma Nitrocarburizing
Jeet Vijay Sah

Investigation of Microwave Produced Plasma at Low Pressure
K. Nigam

Ion Erosion Study of BNSiO2 (Borosil) Related to Plasma Thruster
Basanta Kumar Parida

Effect of External Magnetic Field and Gas Ambient on Iron oxide Nanoparticles Prepared by Arc Plasma Process
Savita

Active Matter and Complex Media 2022, WE-Heraeus Summer School, Corsica, France, 26 September - 7 October 2022

Re-entrant phase separation in a collection of self-propelled non-reciprocally aligning disks
Soumen De Karmakar

8th International Symposium on Negative Ions, Beams and Sources 2022, Padova, Italy, 2-7th October 2022

Source performance optimization in Cesiated mode in ROBIN

Kaushal Pandya, Mahendrajit Singh, Manas Bhuyan, Mainak Bandyopadhyay, Himanshu Tyagi, V. Mahesh, Agrajit Gahlaut, Kartik Patel, Ratnakar Yadav, Sejal Shah, Bhavesh Prajapati, Hiren Mistri and Arun Chakraborty

75th Annual Gaseous Electronics Conference (GEC 2022), Sendai, Japan, 3-7th October 2022

Investigating the plasma dynamics of capacitive discharges driven by pulsed radio-frequency (RF) at low pressure using particle-in-cell simulation
Sarveshwar Sharma, Soham Banerjee, Peng Tian, Jason Kenney, Shahid Rauf, Dmytro Sydorenko, Alexander Khrabrov, Igor D Kaganovich, Andrew T Powi, and Willca Villafana

Investigation of the electro-thermal dynamics of a low pressure DC plasma spray torch
Ram Krushna Mohanta, Ganesh Ravi

Ar plasma nanostructuring of PTFE for the wettability transition from hydrophobic to superhydrophobic and hydrophilic surfaces
Vivek Pachchigar, Umesh K Gaur, Sooraj K. P., Sukriti Hans, Mukesh Ranjan

Observation of Instability driven propagating localized patterns in E×B discharges in 2D-axial azimuthal PIC-MCC simulations
Bhaskar Chaudhury, Teja V Reddy, Durgesh Mishra, Miral Shah, Mainak Bandyopadhyay

Investigating the influence of ion mass on plasma characteristics in low temperature ExB plasmas using 2D-3V PIC-MCC simulations
Bhaskar Chaudhury, Durgesh Mishra, Teja V Reddy, Miral Shah, Mainak Bandyopadhyay

The effect of plasma-activated water in enhancing seeds germination, plant growth, and its use as a nitrogen source for algae growth
Vikas Rathore, Budhi S Tiwari, Sudhir Nema

Low-temperature nitrocarburizing by pulsed-DC discharge of N2-H2-C2H2 for surface engineering of austenitic stainless steel
Jeet V Sah, Alphonsa Joseph, Ghanshyam Jhala, Subroto Mukherjee

The influence of transverse magnetic field on the properties of a 13.56 MHz cylindrical CCRF device
Swati, Pawandeep Singh, Shantanu Karkari

The performance of the pulse bias hairpin resonator probe for negative ion diagnostic
Pawandeep Singh, Swati Swati, Jay K Joshi, Nageswara R Epuru, Yashshri Patil, Shantanu Karkari

6th Asia-Pacific online Conference on Plasma Physics (AAPPS-DPP2022), Division of Plasma Physics, Association of Asia-Pacific Physical Societies, 9-14th October 2022

Excitation of plasma turbulence in cross field diffused plasma of LVPD-U
Ayan Adhikari, A. K. Sanyasi, L. M. Awasthi, P.K. Srivastava, Mainak Bandyopadhyay, and R. Sugandhi

ECR plasma characteristics in a tight aspect ratio device with varying toroidal magnetic field
Tulchhi Ram, Jagabandhu kumar, Devilal Kumawat, P. K. Sharma, Raju Daniel

Hydrodynamic matrix for Yukawa Fluids in the Generalized Hydrodynamics Framework"
Ankit Dhaka, P. Bandyopadhyay, A. Sen, P.V. Subhash

Propagation large amplitude oblique whistler wave

in plasma
Gayatri Barsagade, Devendra Sharma

Modulational instability of dust acoustic waves in strongly coupled Yukawa System
Sandip Dalui, Prince Kumar, Devendra Sharma

Implementation of 3D Monte-Carlo simulations in the inboard limited ADITYA-U scrape off layer plasma
Arzoo Malwal, Bibhu Prasad Sahoo, Devendra Sharma

Induction dynamo using Yoshida-Morrison flow: Generation of large scale magnetic energy
Shishir Biswas, Rajaraman Ganesh

Diagnostics for a fusion grade neutral beam injector
Mainak Bandyopadhyay, DNB team and NNBI team

Characterization of intrinsic plasma rotation in Ohmically heated plasmas of ADITYA-U tokamak using Passive Charge eXchange spectroscopy
Gaurav Shukla, M. B. Chowdhuri, K. Shah, R. Manchanda, N. Ramaiya, K. Patel, K. A. Jadeja, R. L. Tanna, K. B. K. Mayya, J. Ghosh and ADITYA-U Team

Analytical models to examine non-equilibrium plasmas in laboratory devices
Shantanu Kumar Karkari, S. Das, P. Singh, Swati, Y. Patil and A. Pandey

Energy distribution of laser coupled cluster electrons in an ambient magnetic field
Kalyani Swain, Mrityunjay Kundu

42nd Meeting of the ITPA Topical Group on Diagnostics, ITER Organisation, 10-13th October 2022

Thermophysical properties and characterization study of Boron Carbide (B4C) Ceramics developed for ITER
Bhoomi S. Gajjar

25th International Workshop on Electron Cyclotron Resonance Ion Sources 2022 (ECRIS-2022), Institute for Plasma Research, Gandhinagar, 12-14th October 2022

Development of 2.45 GHz ECR Ion Sources at IPR
S. Vala, Ratnesh Kumar, M. Abhangi, H. Tyagi, H. Mistri, K. Kalaria, N. Vaghela, S. Gupta , M. Bandyopadhyay, and Rajesh Kumar

Interplay among cavity modes in a microwave ion source influencing the plasma dynamics and the extracted ion beam
Chinmoy Mallick, Mainak Bandyopadhyay, Rajesh Kumar

Fluctuations in an ECR produced Hydrogen plasma in diverging Magnetic fields in a Large Volume Plasma System
Shweta Sharma, Ashish Ganguli, S. Kar, Ramesh Narayanan, D. Sahu, R.D. Tarey, Mainak Bandyopadhyay, Arun Chakraborty, Mahenderjit Singh

Effect of Length of ECR Region on Electron Temperature and Density in a Multi Charged Ion Source
Ratnesh Kumar, Sudhirsinh J Vala

Functional Characterisation of ECR Ion Source based 14 MeV neutron generator
Mitul Abhangi, Rajesh Kumar, Ratnesh Kumar, Abhishek Saxena, HL Swami, Sudhirsinh J Vala

Overview and summary of the 25th International Workshop on Electron Cyclotron Resonance

Ion Sources 2022 (ECRIS2022)
Mainak bandyopadhyay

6th International Conference on Multibody System Dynamics, Indian Institute of Technology, Delhi, 16-20th October 2022

Passive gravity compensation of serial link manipulators for Remote Handling application
ManoahStephen M

64th Annual Meeting of the APS Division of Plasma Physics, Spokane, Washington, 17-21st October 2022

Particle-in-cell simulation of electron and ion dynamics in low pressure capacitively coupled plasma discharges operated by pulsed radio-frequency (RF)
Sarveshwar Sharma, Soham Banerjee, Peng Tian, Jason Kenney, Shahid Rauf, Dmytro Sydorenko, Alexander Khrabrov, Igor D Kaganovich, Andrew T Powi, and Willca Villafana

The effect of sheath dielectric on the inferred plasma parameters of a DC biased hairpin resonator probe
Pawandeep Singh, Swati Swati, Avnish K Pandey, Jay Joshi, Yashshri Patil, Shantanu Karkari

Two-stage acceleration of electrons by intense laser-cluster interaction in strong magnetic environment
Kalyani Swain, Sagar Sekhar Mahalik and Mrityunjay Kundu

MHD triggered GAM in ADITYA-U tokamak
Kaushlender Singh, H. Raj, T. Macwan, S. Dolui, Ankit Kumar, Bharat Hegde, Ashok Kumawat, P. Gautam, Rohit Kumar, S. Aich, Laxmikanta Pradhan, Ankit Patel, K. Galodiya, K.M. Patel, K.A. Jadeja, L.T. Lachhvani, R.L. Tanna, J. Ghosh

28th National Symposium on Cryogenics and Superconductivity (NSCS-28), IIT Kharagpur, 19-21st October 2022

PHASE-I Design of Data Acquisition and Control System of Large Scale Cryogenics Plant System
V.B. Patel, A.K.Sahu, A.L. Sharma, H.H. Chudasma, H. Masand, H.J. Dave, I.A Mansuri, J.J. Patel, M.K. Bhandarkar, O. Chandratre, P. Gaddam, P. Singh, T.S. Rao, K. Mahajan and LCPC Team

Conceptual design of open source IoT based software solution for Cryogenic experiments
Rameshkumar Joshi

Design and Development of a Prototype Superconducting MgB2 Cable for Current Feeders Application
Nitin Bairagi

Design and manufacturing of ITER cryolines and warmlines: an Indian contribution
Nitin Shah

Design and Performance Analysis of regenerators in cryocooler: A Review and study on the selection of methods
Abhinav B. Desai

Development of prototype pulse-tube refrigerator for typical cryopumps used in fusion devices
Abhinav B. Desai

Development of a customized unit operation and validation using experimental data
Vinit Shukla

Effect of the Geometrical Configuration of Flexible Cryostat on the Hydraulic Characteristic of Cryogenic GHe towards High-Temperature

Superconducting Applications
Mahesh Ghate

Development and Validation of Room Temperature Bore Cryostat for Testing of HTS Solenoid Magnet up to 55 K
Mahesh Ghate

Up gradation of IPR indigenous helium refrigerator plant to liquefier and test results
Haresh J. Dave

Process analysis and helium flow optimization for cold components of indigenous helium refrigerator plant of IPR
N. Patel

Experimental Set-up and Measurement of Isentropic Efficiency of Cryogenic Helium Turbines
Ananta Kumar Sahu

Design Optimization of Heat Exchanger of Helium Refrigerator Plant Considering LN2 Consumption
Ananta Kumar Sahu

Emissivity measurement of multi-layer insulation at room temperature
Uday Kumar

Development of new Supervisory Control and Data Acquisition System for 1.3 kW Helium Refrigerator cum Liquefier at 4.5 K
Pradip Narendrakumar Panchal

Test results of indigenously developed cryogenic 3 -stream plate-fin heat exchanger
Vivek Mishra

Up-gradation of Current Feeder System for Superconducting PF3 Coils in SST-1
Atul Garg

Vapour cooled Current leads operations and control for Nb3Sn coil test
Rohitkumar Natvarlal Panchal

Commissioning and Operational Experience with Cryocooler based Helium Circulation system at 55 K for HTS based applications
Pradip Narendrakumar Panchal

Development of Cryocooler Based Solid Hydrogen Pellet freezing system for Application in High-Temperature Plasma
Jyoti Shankar Mishra

Design, development and experimental demonstration of a lab scale sub-cooled liquId nitrogen system at IPR
Arvind Kumar Tomar

Cryogenic experimental set-up for test of 2-stream plate-fin heat exchanger
Rajnikant P Bhatasana

Indigenous Development of Cryo Compatible Flexible Vacuum Jacketed Cryo Line for 80 K
Rajeev Sharma

32nd ITPA DivSOL TG meeting, Cadarache, France, 24-28th October 2022

On the modification of edge turbulence by impurity seeding
Nirmal Kumar Bisai

27th National Conference on IC Engines and Combustion (NCICEC2022) organised by VIT Vellore, 6th November 2022

Numerical Simulation of Diesel Combustion Passing through High Power Arc Region in a Plasma Fuel System
Sunil Bassi

14th International Conference & Exhibition on Materials, Engineering, Technology and Advances in Heat Treatment (MET+HTS 2022), ASM International, Mumbai, 2-4 November 2022

On the oxidation resistance of plasma processed aluminide coated titanium alloys (Ti6Al4V)
Tejas Parekh, Payank Patel, A. B. Zala, C. Sasmal, N. I. Jamnapara

Effect of DBD plasma treatment on surface modification of aramid fibers: XPS study
Sadaf Jethva, F. Bhabhor, C. Patil, V. Desai, A. B. Zala, N. Chandwani, C. Balasubramanian, N. I. Jamnapara

13th Biennial National Conference of Physics Academy of North East (PANE), Manipur University, Imphal, Manipur, 8-10 November 2022

Study on radiations emitted from an inertial electrostatic confinement fusion device and their applications"
D. Bhattacharjee, L. Saikia, S. Kalita, and S. R. Mohanty

Enhancement in neutron production rate via adaptation of different confinement mechanisms in a cylindrical inertial electrostatic confinement fusion device
L. Saikia, D. Bhattacharjee, S. Kalita and S. R. Mohanty

31st International Toki Conference on Plasma and Fusion Research (ITC-31), Online, 8-11 November 2022

Investigation of temporal evolution of hard X-ray spectrum from Neon seeded plasma of ADITYA-U Tokamak
Shishir Purohit, M.K. Gupta, M.B. Chowdhuri, U.C. Nagora, Yashika Taunk, Abhishek Kumar, Kajal Garg, S.K. Pathak, K.A. Jadeja, Rohit Kumar, K. Tahiliani, S.K. Jha, K.M. Patel, R.L. Tanna, Supriya Nair, J. Ghosh and ADITYA-U Team

Hard X-ray analysis for ADITYA/ADITYA-U limiter plasma
Kajal Garg, Shishir Purohit, Virendra Ranga, Manoj Kumar Gupta, Joydeep Ghosh

Effect of convective transport on cross-field plasma particle and energy fluxes in edge/SOL plasmas of ADITYA-U tokamak
Ritu Dey, J. Ghosh, M.B. Chowdhuri, S. Dolui, K. Singh, R.L. Tanna and ADITYA-U Team

Engineering analysis of the Prototype Center Stack structure for Spherical Tokamak
Ranjith Kumar Santharam
Development of a fast solenoid valve assisted mechanical launcher for cryogenic pellets
J. S. Mishra, P. Panchal, S. Mukherjee, V. Gupta, H. S. Agravat, P. Nayak and R. Gangradey

7th International Conference on Ion Beams in Materials Engineering and Characterization (IBMEC 2022), Inter-University Accelerator Centre (IUAC), New Delhi, 16-19 November 2022

Low energy ion-beam induced pattern formation on sputtered Al films for achieving manifold SERS enhancement
Mahesh Saini

20th International Congress on Plasma Physics (ICPP-2022), Gyeongju, South Korea, 27 November - 2 December 2022

Magnetic Confinement of primary electrons in a ring cusp ion source
Bharat Singh Rawat

Electrode Biasing Effect on Radial Characteristics of Magnetized Plasma in Linear Device
Satadal Das, Shantanu Karkari

DAE-BRNS National Laser Symposium (NLS-31), Department of Physics, Indian Institute of Technology Kharagpur, West Bengal, 3-6 December 2022

Experimental Setup for contamination study inside a vacuum chamber using an optical cavity
S. Sunil, Arnab Dasgupta, Hitesh Gulati and Amit K Srivastava

International e-Symposium on Plasma for Energy (ISPE-2022)" SRMIST, Tamil Nadu, 5-6 December 2022

Plasma based (Magnetron sputtering) thin film deposition for solar cell applications
Sagar Agrawal

37th National Symposium on Plasma Science & Technology (Plasma-2022), Indian Institute of Technology, Jodhpur, 12-14 December 2022

Effect of External Grids on Ion Flow Dynamics in an Inertial Electrostatic Confinement Fusion Device
L. Saikia, D. Bhattacharjee and S. R. Mohanty

Wave breaking Amplitude of Relativistically Intense Longitudinal Waves in Cold Magnetized Plasma
Nidhi Rathee, Sudip Sengupta

Influence of Electron Temperature Inhomogeneity on Radial Density Profile in Cylindrical Discharges
Swati Swati, Pawandeep Singh, Satadal Das, Avnish K. Pandey, Shantanu K. Karkari

Studies on the Retarded Recrystallization of Tungsten in CIMPLE-PSI, Exposed Under Extreme Surface Temperature and He+ Fluence
Mizanur Rahman, S. Chetri, Bryan Teo, M. Thompson, M. Bilokur, S. Shekhar, C. Corr, G. De. Temmerman and M. Kakati

Energy Confinement Studies of Hydrogen and Deuterium Ohmically heated plasmas in ADITYA-U tokamak
R.L. Tanna, H. Raj, J. Ghosh, Chetna Chauhan, K.A. Jadeja, R. Kumar, Suman Aich, K.M. Patel, S. Patel, K. Singh, S. Dolui, A. Kumar, B. Hegde, A. Kumawat, M.N. Makwana, K.S. Shah, S. Gupta, S. Nair, N. Yadava, N. Ramaiya, M.B. Chowdhuri, R. Manchanda, U.C. Nagora, Kiran Patel, S. Purohit, A. Adhiya, M.K. Gupta, Varsha S, S.K. Jha, D. Kumawat, K. Tahiliani, P.K. Atrey, S.K. Pathak, Y.C. Saxena and ADITYA-U team

Overview of Remote Handling and Robotics Technology Developments in IPR
Krishan Kumar Gotewal, Naveen Rastogi, Manoah Stephen, Ravi Ranjan Kumar, Jignesh Chauhan

Compact ECR Large Area Plasma Source as a Potential Negative Hydrogen Ion Source for Fusion Application
Shweta Sharma, D. Sahu, R. Narayanan, R. D. Tarey, S. Kar, A. Ganguli, M. Bandyopadhyay, A. Chakraborty, M. J. Singh

Ar Plasma nanostructured superhydrophobic surfaces for self-cleaning
Vivek Pachchigar, Mukesh Ranjan

Understanding the Physical Processes Prevailing in

the Edge Plasma Region of ADITYA-U Tokamak using Spectroscopic Measurements
Nandini Yadava, J. Ghosh, M. B. Chowdhuri, Ankur Pandya, S. Patel, Ritu Dey, Sripathi Punchithaya K., R. Manchanda, Nilam Nimavat, K. A. Jadeja, R. L. Tanna, and ADITYA-U team

Cold Plasma Treatment for Surface Modification of Ceiba Pentandra Fiber
Ramyaranjan Das, Mukesh Ranjan, Dillip Kumar Bisoyi

Overview of IN-DA Diagnostics for ITER
Abha Maheshwari, Anil Bhardwaj, Anil Tyagi, Avik Bhattacharya, Bharathi Magesh, Bhargav Choksi, Bhoomi Gajjar, Deepak Mangde, Dilip Shukla, Gheesa Vyas, Hitesh Pandya, Kumar Rajneesh, Kunal Bhatt, Mahesh Patel, P V Subhash, Pratik Vagasiya, Ravinder Kumar, Ronak Shah, Sapna Mishra, Sarabjeet Singh, Saroj Jha, Shivakant Jha, Shriprakash Verma, Shrishail Padasalagi, Siddharth Kumar, Suman Danani, Suraj Pillai, Vinay Kumar, Cheng Zhifeng, Liu Yong, Marteen De Bock, Martin O' Mullane, Novimer Pablant, Philippe Bernascolle, Pak Sunil, Robin Barnsley, Kishonbabu K, Raphael Tieulent, Victor Udintsev, & Michael Walsh

Design and installation of fast reciprocating drive system for ADITYA-U Tokamak
Kaushlender Singh, Bharat Hegde, Ashok K. Kumawat, M.S. Khan, Ankit Kumar, Suman Dolui, Laxmikanta Pradhan, Ankit Patel, K.A. Jadeja, K.M. Patel, Tanmay Macwan, Harshita Raj, Pramila Gautam, Rohit Kumar, Suman Aich, Imran Mansuri, Abhijeet Kumar, Kalpesh Galodiya, R.L. Tanna, Joydeep Ghosh, and ADITYA-U Team

A Collimated Electron Beam from the Laser-Driven Deuterium Cluster in Ambient Magnetic Field
Kalyani Swain, Mrityunjay Kundu

Experimental Observation of Coulomb Screening and Coulomb Acoustic Wave in Nanodusty Plasmas
Bidyut Chutia, K. Avinash, S. K. Sharma and H. Bailung

Collective excitations of strongly coupled systems under the Quasi-localized charge approximation (QLCA) framework
Prince Kumar and Devendra Sharma

Characterization of Spiral Antenna-Based RF-plasma in Multi-Dipole Line Cusp Magnetic Field
M. A. Ansari, A. D. Patel, Prabal K Chattopadhyay, Raj Singh and N. Ramasubramanian

Nonlinear Excitations in Strongly Coupled Yukawa System under Quasi Localized Charge Approximation (QLCA) Approach
Sandip Dalui, Prince Kumar, Devendra Sharma
Dynamics of Magnetized Plasma Sheath in the Context of Nonextensively Distributed Species
R. Paul, K. Deka, G. Sharma, R. Moulick, S. Adhikari, S. S. Kausik, B. K. Saikia

Investigating the Validity of Boltzmann Relation for Electrons in a Magnetized Plasma Sheath
G. Sharma, R. Paul, K. Deka, R. Moulick, S. Adhikari, S. S. Kausik, B. K. Saikia

Design, Simulation, Development and Testing of a High Power Microwave (HPM) DC Break for SYMPLE
Priyavandna J. Rathod and Anitha V. P.

Role of Neutral Gas Flows in Double Layer Formation and Thrust Generation in an Expanding Magnetic Field Plasma
Vinod Saini, Rajaraman Ganesh

Formation of Axial Potential Structures in Oxygen RF Plasma
P.K. Saha, M. Chakraborty, A. Mukherjee

Finite Element Simulation of Plasma Production in a Cusp Field Linear Device
A. Amardas, Raj Singh, Amit D. Patel

Laser-Induced Photodetachment for the Negative Ions Detection Using Hairpin Probe into the SPIN-Ex Plasma Device
E. Nageswara Rao, Pawandeep Singh, D. Swati, A. K. Panday, Y. Patil and Shantanu Karkari

Scheme for Microwave Mode Excitations to Have Different Effective Angle of Incidences in SYMPLE
Anitha V. P. and Priyavandna J. Rathod

Pulsed Afterglow Plasma for Studies on Electron Magneto-Hydrodynamic Structures
Ambesh Kumari, Kushagra Nigam, G Ravi

Role of Argon Metastable States inside Argon-Nitrogen RF Plasma
A. Mukherjee, M. Chakraborty, P.K. Saha

Observation of Electron Temperature Anisotropy in the Double Plasma Device
Jocelyn Sangma, A. R. Baitha, M. Chakraborty

Plasma Sheath with Two Species of Positive Ions and Surface Produced Negative Ions
Sutapa Samanta, Rakesh Moulick, P. J. Bhuyan, and B. J. Saikia

Particle Simulations of Tearing and Surface Preserving Modes in Electron Current Layers
Sushmita Mishra, Gurudatt Gaur, and Bhavesh Patel

Understanding Transverse Diffused Plasma and Excited Turbulence in LVPD-U
Ayan Adhikari, A. K. Sanyasi, L. M. Awasthi, P. K. Srivastava, Mainak Bandyopadhyay and R. Sugandhi

Understanding Cross Field Density Depletion Phenomenon in LVPD-U Plasma
Ayan Adhikari, A. K. Sanyasi, and L.M. Awasthi

Role of Neutral Gas Flows in Double Layer Formation and Thrust Generation in an Expanding Magnetic Field Plasma
Vinod Saini, Rajaraman Ganesh

Ion Beam Induced Nanopatterning of Borosil Related to Plasma Thruster
Basanta Kumar Parida, Vivek Pachchigar, Sooraj K P, Sukriti Hans, Sebin Augustine, Mukesh Ranjan

Investigations of Shocks and Solitary Structures in Four Components Strongly Coupled Unmagnetized Astrophysical Dusty Plasma
J. Goswami and S.S. Kausik

Directed Motion in a 2D System of Yukawa Particles on 1D Ratchet
Anshika Chugh, Rajaraman Ganesh

Development of Configuration Management Software for Laboratory Plasma Experiments
R. Sugandhi, V. Soumya, Ayan Adhikari, A. K. Sanyasi, and L. M. Awasthi
Lane Formation in 3D Pair-Ion Plasmas Driven by Non-Parallel External Forcing
Vishal Kumar Prajapati, Swati Baruah, Rajaraman Ganesh

Effect of Axial Magnetic Field on a Cylindrically Symmetric Electronegative Discharge
Avnish Kumar Pandey, Pawandeep Singh, Swati

Dahiya, Shantanu Kumar karkari

Possible Applications of SMES from India's Perspective
A. N. Sharma, V. L. Tanna and P. K. Atrey

Study of Plasma Sheath in the Presence of Dust Particles in a Magnetic Mirror-like Field Configuration
K. Deka, G. Sharma, R. Paul, R. Moulick, S. Adhikari, S. S. Kausik, and B. K. Saikia

Kelvin-Helmholtz Instability in a Compressible Dust Fluid Flow
Krishan Kumar, Pintu Bandyopadhyay, Swarnima Singh, Vikram S. Dharodi, Abhijit Sen

Experimental Demonstration of Structural Phase Transition in 2-D Complex Plasma Crystals Swarnima Singh, Krishan Kumar, P. Bandyopadhyay and A. Sen

Layer Formation in Stratified 3D Yukawa Liquids
Suruj Kalita, Rajaraman Ganesh

Self-Excited Vortex Formation in Three Dimensional Dusty Plasma
Sachin Sharma, Meenakshee Sharma, G Veda Prakash, Yogesh Saxena, and Sanat Tiwari

Hydrodynamic Stability of Convective Cells in 2D Complex Plasmas
Pawandeep Kaur, Jagannath Mahapatra, Rajaraman Ganesh

Active Complex Plasma: A New Paradigm of Research
Soumen De Karmakar and Rajaraman Ganesh

Characterizations of Spontaneous Fluctuations in Strongly Coupled Dusty Plasmas
Ankit Dhaka, PV Subhash, Pintu Bandyopadhyay, A. Sen

Analytical Studies of Dust Acoustic Waves with Kappa Distributive Ions and Electrons in a Viscous Dusty Plasma
J. Goswami and S.S. Kausik

Korteweg-De Vries Model Based Nonlinear Dispersion Relations for Dust Acoustic Wave
Farida Batool, Ajaz Mir, Sachin Sharma, Abhijit Sen and Sanat Tiwari

Collisionless Shock Formation in Field-aligned Plasma Flow from Accretion Disk towards Poles in Neutron Stars
Anoop Singh, Mrityunjaya Kundu and Shishir P. Deshpande

Compressible Effects on Force-free 2d Magnetic Flux Tubes
Jagannath Mahapatra, Rajaraman Ganesh, and Abhijit Sen

Numerical Simulation of Coal Devolatilization Process in Presence of High Power Plasma Arc in Plasma Fuel System
Sunil Bassi, S.K. Nema, A. Sanghariyat, C. Patil, P.V. Murugan, Shashank Chaturvedi

Comparative Study of Dielectric Barrier Discharge Plasma with Different Configurations
Trivesh Kant, Kushagra Nigam, Abhijit Boruah, Chirayu Patil, B. Sahoo, G Ravi

Surface Modification of Bharat Merino Wool (BMW) for Improving Its Shrink Resistance Using Atmospheric Pressure Non-Thermal Air Plasma and Bio-Polymer Coating
Nisha Chandwani, Vinod Kadam, Atik Mistry, Vishal Jain and S.K.Nema

Development of Glass-Metal Joint for Plasma Antenna System
Vinod Kaila, Siju George, Rajan Babu, Vijay Patel, Dilip Raval, Prabal K. Chattopadhyay

Thermal Performance Analysis of Gate Valve Assembly with Cooling Provision for Safe Handling of Bio-Medical Waste Packets in Plasma Pyrolysis System
Atikkumar N. Mistrya, Deepak Sharmaa, Paritosh Chaudhuri,a,b, S.K. Nema

Design and Development of Plasma Activated Water Setup and Optimization of Process Parameters and its Applications (Healthcare, Food Preservation, and Agriculture)
Vikas Rathore, Divyesh Patel, Shital Butani, Sudhir Kumar Nema

Surface Modification of High Density Polyethylene (HDPE) Geomembranes Using Atmospheric Pressure Nonthermal Air Plasma
Vishal Jain, Nisha Chandwani, Royal Christian, S.K.Nema

Increase in Cluster Size along the Flow Direction in Supersonic Expansion.
Milaan Patel, Jinto Thomas, Hem Joshi

Emission of Terahertz Radiation by Oblique Incidence of Laser on Inhomogeneous Plasma
Anjana K P, Mrityunjay Kundu
Anisotropic Emission from Laser Produced Plasma Using Optical Emission Spectroscopy
Geethika B R, Garima Arora, Jinto Thomas, Hem Chandra Joshi

Effects of Radiation-Reaction on Resonant Phase Locking In Cyclotron Auto-Resonant Particle Acceleration Scheme
Shivam Kumar Mishra Sudip Sengupta and Sarveshwar Sharma

Design, Fabrication, Testing, Installation and Commissioning of Exhaust System for Trititum Handling and Recovery System of Accelerator Based 14 Mev Neutron Generator
Sudhir Tripathi, Manoj K. Gupta, Mitul Abhangi, Sudhir Vala, H.L.Swami

Studies on Spatial Evolution of Pulsed Helium Plasma
S. Singha, A. Ahmad, N.K. Neog, T.K. Borthakur

Conceptual Design of Prototype Pulsed Alternator
Rambabu Sidibomma, Prasad Rao Pedada, Ankur Jaiswal, YSS Srinivas and E Rajendra kumar

Plasma Interaction with Tumor Tissues Associated with Drug Resistant Epilepsy (DRE) Pathologies
Akshay Vaid, Yogesh Aggarwal, Ramkrishna Rane, Anand Visani, Aparna Dixit, Ramesh Doddamani, Manjari Tripathi, P.Sarat Chandra, Alphonsa Joseph, Jyotirmoy Banerjee

Studies on Microbial Inactivation Using Plasma Sterilization
Tejal Barkhade, Kushagra Nigam, G. Ravi, Seema Rawat and Sudhir Kumar Nema

Comparative Study of Dc and High Power Impulse Magnetron Sputtering for Copper Thin Film Deposition
R. Rane, P Maila, A. Joseph

Shock Free Non-Thermal Atmospheric Plasma Jet at Radio Frequency
Abhijit Majumdar, Suranjana Banerjee,Sadhan handra Das,Subrato Mukherjee

Spectroscopic Investigation of Plasma Treatment of Coal in RF Generated Plasmas

Dipexa Modi, Kundan Viliya, Nandini Yadava, Sachin S. Chohan, A. Sarkar, Amulya Sanyasi, Uttam Sharma, Jayashree Sharma, Malay B. Chowdhuri, Joydeep Ghosh, Balamurli Krishna Mayya, Uttam Bhui, Sudip Bhattacharyya, Krittibas Das, Jitendra Kumar

NF3 Based Plasma Etching System for Etching of Silicon Substrate
Vrushank Mehta, Rajesh Kumar, Y. Kumar, H. L. Swami, C. Jariwala

Enhanced Optical Properties by Argon Plasma-Induced Surface Texturing on the Silicon Surface
Y. Kumar, V. Mehta, C. Jariwala, H. L. Swami, S. Hans, M. Ranjan, R. Kumar

Booster System Performance Test after Electrical Refurbishment
Rakesh Patel, Gaurang Mahesuria, Rohit Panchal, G.L.N. Srikanth, Dikens Christian, Pankil Shah, Ketan Patel, Pradip Panchal, Hiren Nimavat and Vipul L Tanna

Design of Water Cooled Helholtz Coils for Hydrogen Isotope Permeation Barrier Coating Experiment
Vilas Chaudhari, Arvind Kumar, P. A. Rayjada, Y.S.S. Srinivas

Engineering Design of Central Solenoid (CS) Coil for Small Scale Spherical Tokamak (SSST)
Arvind Kumar, Vilas C Chaudhari, S Ranjithkumar, Ananya Kundu, YSS Srinivas, E Rajendra Kumar

Development of an Ice Pellet Injector for the Multipurpose Application in a High-Temperature Plasma
J. Mishra, P. M. Panchal, S. Mukherjee, V. Gupta, H. Agravat, M. Banaudha, P. Nayak, R. Gangradey

Comparative Study of Refractive Optics Based Endoscope and Wound Imaging Fiber Bundle
Suraj Kumar Gupta, Vishnu Chaudhari, Manoj Kumar

Development of Serial Wireless Module for the Remote Operation of Various Auxilliary Systems in ITER-India Test Gyrotron Facility
Deepak Mandge, E. Sharan Dilip, Rajvi Parmar, Vipal Rathod, Ronak Shah, Amit Yadav, Anjali Sharma, S.L. Rao and Kumar Rajnish

Design of Cooling Water System for ITER-India Laboratory
R. Ranjan, D. K. Gupta, R. Agarwal, L. Sharma, S. Jha, M. Chodavadiya, N. Parmar

Experimental and Numerical Characterization of Ceramic Pebble Beds under Cyclic Loading
Maulik Panchal, Chirag Sedani, Harsh Patel, Paritosh Chaudhuri

Up Gradation of Controller and Load Test for 1700KVA DG Set No.1
Chirag Bhavsar, Chandra Kishore Gupta, G.K.Rajan, Supriya Nair, Prakash Parmar

Measurement of Radial Magnetic Field in ADITYA-U Tokamak
A.Kundu, S.Aich, L.K.Pradhan, R.Kumar, Praveenlal E V, A.Kumar, J.Ghosh, R.L.Tanna, S.Dolui,K. Singh, A.Kumar,A.Kumawat, B.Hegde, K.A. Jadeja, K.M.Patel, A.Patel,H.Raj,S.Patel,K. Galodiya,N.Nimavat, A. Kanik, N.Yadava, K. Shah and the ADITYA-U team

Instrument Reliability - Maintenance in SST-1 Cryogenic Warm Gas Management
Gaurang Mahesuria, Rohit Panchal, Pankil Shah, Ketan Patel, Rakesh Patel, Pradip Panchal, Hiren Nimavat and Vipul L Tanna

Parameter Choices and Constraints for Indian DEMO
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3D Computational Fluid Dynamics Simulation of Heat Transfer for PINI Ion Source Back Plate
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Preliminary Electromagnetic Analyses of Linear Induction Motor as Sn-Li Alloy Stirrer
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Design, Development and Testing Results of Fault Processing Card for FRBPS
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Development of Supervisory Control and Data Acquisition Application for Cryocooler based Helium Circulation System at 55K
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Cleaning and Contamination Control Methodology for Large Ultra High Vacuum (UHV) Chamber
Rakesh Kumar, Sunil S, Vijay Bedakihale, Subroto Mukherjee

Arbitrary Pulse Generator using Xilinx FPGA for Tokamak Gas Fueling Control Circuit

Bharatkumar Arambhadiya, Hiteshkumar Mandlia, Vismaysinh Raulji, Mohammad Shoaib Khan, Kaushlender Singh, Rachana Rajpal, Kumarpalsinh Jadeja, Rohit Kumar, R.L Tanna, Joydeep Ghosh

Upgraded Real-Time Feedback Control System for Horizontal Plasma Position Stabilisation
Pramila Gautam, Vismaysinh Raulji, Rohit Kumar, Rachana Rajpal

Conceptual Design of an Isolated Control System for Floating Power Supply of NBI for SST-1
Laxmi Kant Bansal, Paresh J Patel, Dipal Thakkar, Vijay V Vadher, Laxmi Narayan Gupta, C.B. Sumod, Karishma Qureshi, U K Barua

Design & Analysis of Hydrogen Gas Pre-Cooler for Solid Hydrogen Pellet Injections System of the Tokomak
P. Nayak. S. Mukherjee, P. Panchal, H. agravat, R. Gangradey, J. Mishra, V. Gupta

Fault Assessment on 3300 kVA Multi-secondary Transformer of Regulated High Voltage Power Supply
L.N.Gupta, Paresh J. Patel, N.P.Singh, Dipal Thakkar, Sumod C.B, Bhavin Raval and U.K.Baruah

Factory Acceptance Tests Conducted on Repaired 3300 kVA Multi-Secondary Transformer of Regulated High Voltage Power Supply
Dipal Thakkar, L.N.Gupta, Paresh J. Patel, N.P.Singh, Sumod C.B, Bhavin Raval and U.K.Baruah

Welding development during Manufacturing and Assembly of ITER Cryostat
Rajnikant Prajapati, Anil Bhardwaj, Vaibhav Joshi, Amit Palaliya, Mukesh Jindal, Mitul Patel, Avik Bhattacharya, Gaurav Jogi, Jimmy Dutt, Chirag Patel, Sivakumar

Alternate Technology for Manufacturing of Actively Cooled Components for Neutral Beam
Ashish Yadav,Jaydeep Joshi, Amit Arora, Sooraj Patel, Mahendrajit Singh, Arun K Chakraborty

Non-Thermal Electron Studies for ADITYA/ ADITYA-U Tokamak Plasma via X-Rays Spectroscopy
S. Purohit, M. B. Chowdhuri, M.K.Gupta, J. Ghosh, K. A. Jadeja, S. K. Pathak, R.L. Tanna

Liquefaction Rate Measurement Set-Up and Test Results of Indigenous Helium Liquefier Plant of IPR
O. Chandratre, A K Sahu, P.Singh, H. Dave, V. B. Patel, H. Kavad, R. Bhatasana, N. Kumar and P. Brahmbhatt

Overview of Electrical Power Network of the 1MW, 170GHz, 3600s ITER India Gyrotron Test Facility
E. Sharan Dilip, Vipal Rathod, Ronak Shah, Shk Madeena Valli, Rajvi Parmar, Deepak Mandge, Amit Yadav, Anjali Sharma, N.P. Singh and S.L. Rao

Python Based Data-Analysis Utility for Non-Neutral Plasma Experiment: SMARTEX-C
Manisha Bhandarkar, Imran Mansuri, Lavkesh Lachhvani, Nikhil Mohurle, Yogesh G. Yeloe,Manu Bajpai, Sambaran Pahari, Kirti Mahajan, Prabal K. Chattopadhyay

3D Plasma Transport Equilibrium Study in the Inboard Limited ADITYA Upgrade Scrape-Off Layer
Arzoo Malwal, Bibhu Prasad Sahoo, Devendra Sharma

Initial Results of the Laser Heated Emissive Probes in the ADITYA-U Glow Discharge Plasma
Abha Kanik, Joydeep Ghosh, Arun Sarma, Kalpesh Galodiya, Laxmikanta Pradhan, Ankit Patel, Minsha Shah, Kaushlender Singh, Bharat Hegde, Tanmay Macwan, Sharvil Patel, R. L. Tanna, Kumarpal Jadeja, Ankit Kumar, Ashok Kumar, Santosh Dubey, Suman Aich, Rohit Kumar, Kaushal Patel, and ADITYA-U Team

A Study of Empirical Relation for Observed Core Ion Temperature with Other Operational Parameters of ADITYA Plasma Discharges
Kumar Ajay, Snehlata Aggarwal, Santosh P. Pandya and ADITYA Team

Design, Simulation, Testing & Installation of Wave Collection and Transport System for Michelson Interferometer Diagnostic at SST-1 Tokamak
Abhishek Sinha, Sonam Sharma and S. K. Pathak

First Result of Thomson Scattering Diagnostics on SST – 1
Neha Singh, Vishnu Chaudhari, Pabitra Kumar Mishra, Kiran Patel, Jinto Thomas and Hem Chandra Joshi

The Simulation of Line Profile of C5+ Impurity Ions Emission Influenced By Zeeman Effect in ADITYA-U Tokamak
Abhishek B, J. Ghosh, M. B. Chowdhuri, Sripathi Punchithaya K, N. Yadava, K. A. Jadeja, R. L. Tanna and ADITYA-U Team

Simulation of Hard X-ray Spectrum for ADITYA Limiter Plasma using Geant4
K. Garg, S. Purohit, V. Ranga, M.K. Gupta, J. Ghosh

Identification of Edge in Tokamak Plasma Using Visible Imaging in ADITYA-U
S. Aich, S. Patel, J. Ghosh, L.K. Pradhan, N. Yadava, N. Nimavat, P. Shrivastava, R.L. Tanna, M.B. Chowdhury, K. Singh, S. Dolui, A. Kumar, B. Hegde, A. Kumawat, K.A. Jadeja, K.M. Patel, H. Raj, A. Patel, R. Kumar and ADITYA-U team

Postmortem Analysis of Coatings on Viewport of SST-1 Using LIBS and Microraman Technique
Pabitra Kumar Mishra, Neha Singh, Jinto Thomas, and Hem Chandra Joshi

Optical Grayness Factor and Its Effect on Electron Cyclotron Emission Measurements during Transient and Steady State Conditions
Varsha Siju and SK Pathak

Study of Instability in Low Pressure Plasma Generated by the Pulsed Washer Gun inside a Curved Vacuum Chamber
P Das, R Paikaray, B K Sethy, R K Barad, S Samantaray, G Sahoo, A K Sanyasi, J Ghosh

Development of an algorithm for the Inversion of Line Integrated Emissivity Measurements from Tokamak Plasma
Vinit Pandya, Kumudni Tahiliani, Santosh Pandya, and Surya Kumar Pathak

Design and Testing of Thermo-electric Cooler Controller for Detection sub-System of Thomson Scattering Diagnostic
Vishnu Chaudhari, Neha Singh, Pabitra Mishra and Jinto Thomas

Development of an Alignment System for ITER-CXRS-Pedestal Diagnostics
Abha Maheshwari, Gheesa L Vyas, Bharathi Magesh, Hitesh K Pandya

Upgradation of Diamagnetic Diagnostics on SST-1
Sameer Kumar, Kumudni Tahiliani, Praveen Lal

Eduppa, Suresh I, Yuvakiran Devaraj Paravastu, Surya Kumar Pathak, Daniel Raju and SST-1 Team

Determination of Electron Temperature of a Pulsed Washer Gun Plasma using Triple Langmuir Probe
B K Sethy, R Paikaray, P Das, S Samantaray, G Sahoo, A K Sanyasi, J Ghosh

Behavioral Modeling of High Temperature Plasma Diagnostic Plant I&C System
Shivakant Jha, Gheesa Vyas, Nidhi Mehra, Sriprakash Verma, Hitesh Pandya

Tangential View Soft X-ray Imaging Diagnostics for ADITYA-U Tokamak
A. Adhiya, M. K. Gupta, S. K. Gupta, A. Kumar, and S. K. Pathak

Analysis of VUV spectral lines for Investigating Impurity Behaviour in ADITYA and ADITYA-U Tokamak
Vishal Sharma, M. B. Chowdhuri, Sharvil Patel, Nandini Yadava, Nilam Ramaiya, Ranjana Manchanda, Manish Rathor, Rakesh L. Tanna, Kumarpal A. Jadeja, Kaushal M. Patel, Joydeep Ghosh, ADITYA, and ADITYA-U1 Team

Edge Plasma Study using Fast Visible Imaging Diagnostic in ADITYA-U Tokamak
Devilal Kumawat, Kumudni Tahiliani, Sameer Kumar, Suresh I, R.L Tanna, Kaushal M Patel, Kumarpalsinh Jadeja, Rohit Kumar, S.K Pathak, Joydeep Ghosh, and ADITYA-U Team

Preliminary Results of Magneto-Optic Current Sensor (MOCS) Diagnostic Developed for Plasma Current Measurements in ADITYA-U Tokamak
Santosh P. Pandya, Kumudni Tahiliani, I. Suresh, Hrishikesh Kathale, Shivam Dobariya, Praveenlal E. V. , Jahanvi Lalwani, Sameer Kumar Jha, Lavkesh T. Lachhvani, Suman Aich, Rohit Kumar, Surya Kumar Pathak, Rakesh L. Tanna and Joydeep Ghosh

Saturation Current Ratio Method: Can It Be Really Useful for Negative Ion Diagnostic?
Pawandeep Singh, Swati Swati, Avnish k Pandey, Shantanu Karkari

RF Compensated Langmuir Probe for the Diagnostics of Plasma Parameters in Magnetized Capacitively Coupled Plasma Discharge
Akanshu Khandelwal, Dhyey Raval, Ravi Ranjan, Y. Patil and Nishant Sirse, S. Karkari

High Impedance Langmuir Probe Diagnostics for Toroidal Non-Neutral Plasma Experiment: SMARTEX-C
Nikhil Mohurle, Lavkesh Lachhvani, Rajiv Goswami, Yogesh G. Yeole, Minsha Shah, Sambaran Pahari and Prabal K. Chattopadhyay

Initial Results of the Laser Heated Emissive Probes in the ADITYA-U Glow Discharge Plasma
Abha Kanik, Joydeep Ghosh, Arun Sarma, Kalpesh Galodiya, Laxmikanta Pradhan, Ankit Patel, Minsha Shah, Kaushlender Singh, Bharat Hegde, Tanmay Macwan, Sharvil Patel, R. L. Tanna, Kumarpal Jadeja, Ankit Kumar, Ashok Kumar, Santosh Dubey, Suman Aich, Rohit Kumar, Kaushal Patel, and ADITYA-U Team

A Study of Empirical Relation for Observed Core Ion Temperature with Other Operational Parameters of ADITYA Plasma Discharges
Kumar Ajay, Snehlata Aggarwal, Santosh P. Pandya and ADITYA Team

CODAC Based Control System for Prototype Hot Source Operation for Local Calibration of ECE Diagnostic System
Shivakant Jha, Ravinder Kumar, Suman Danani, Hitesh Pandya

Development of a Photodiode-Based Detection System for the Measurement of X-Ray Photon Flux
G Shukla, S Mishra, M Shah, S Varshney, H.B. Pandya

Systematic Analysis of Whistler Wave from Fluid to Kinetic Limit with Phase Space Dynamics
Anjan Paul, Devendra Sharma

Excitation of Electrostatics Oscillations and their Modification by Nonlinear Whistlers
Gayatri Barsagade, Devendra Sharma

Design of Laser Induced Breakdown Spectroscopy (LIBS) based wall monitoring diagnostics for ADITYA-U Tokamak
Bharat Hegde, Harshita Raj, Ashok Kumawat, Ankit Kumar, Kaushlender Singh, Suman Dolui, Rohit Kumar, Suman Aich, Laxmikanta Pradhan, Ankit Patel, K. Galodiya, K.M. Patel, K. A. Jadeja, R.L. Tanna, J. Ghosh and ADITYA-U Team

Results and Lessons from Initial Shaped Plasma Experiments in ADITYA-U Tokamak
Harshita Raj, R.L. Tanna, R. Kumar, J. Ghosh, K.A. Jadeja, Suman Aich, K.M. Patel, K. Singh, S. Dolui, A. Kumar, B. Hegde, A. Kumawat, M.N. Makwana, S. Gupta, S. Nair, N. Yadava, N. Ramaiya, M.B. Chowdhuri, R. Manchanda, U.C. Nagora, S. Purohit, A. Adhiya, M.K. Gupta, S.K. Jha, S.K. Pathak, and ADITYA-U team

IEEE Microwaves, Antennas, and Propagation Conference (MAPCON 2022), Bangalore, 12-15 December 2022

RCS Reduction of Microstrip Patch Antenna Using Ku-Band Perfect Polarization Convertor Metasurface
Priyanka Tiwari, Surya Pathak

Preliminary Experimental Studies of the Proposed High Power RF Antenna to Assist Glow Discharge Cleaning of SST-1 at Low Pressure
Mumtaz Ali Ansari, Uttam Kumar Goswami, Dharmendra Rathi, Yuvakiran Devaraj Paravastu, Siju George, Kalpesh R Dhanani, Promod K Sharma, Raju Daniel, Raj Singh

Transmission Characteristics of Plasma-Based Microwave Absorbing Panel in Near and Far Field Region of the Testing Antenna
Rajan Babu, Hiral B Joshi

Reconfigurable Plasma Antenna Array for Beamsteering Application at S-Band
Manisha Jha, Nisha Panghal, Rajesh Kumar, Surya Pathak

19th International Conference on Perspectives in Vibrational Spectroscopy (ICOPVS-2022), Devi Ahilya Vishwavidyalaya, Indore, 13-17 December 2022

SERS-based detection for Food, Agriculture and Medical Science Application
Mukesh Ranjan, Mahesh Saini, Sebin Augustine, Sooraj KP

Spectroscopic Investigations on Ca-doped BiFeO3 Multiferroic Thin Films
Chirag Savaliya, Sadaf Jethva, Savan Katba, Ashish Ravalia and D.G. Kuberkar

Morphology induced large magnetic anisotropy in obliquely grown nanostructured thin film on nanopatterned substrate
Anup Kumar Bera, Arun Singh Dev, Manik Kuila, Mukesh Rajan, Pallavi Pandit, Matthias Schwartzkopf, Stephan V. Roth, Varimalla R. Reddy and Dileep Kumar

A Novel Approach for Improving SERS-Based Molecular Detection Efficiency
Mahesh Saini, Vivek Pachchigar, Sebin Augustine, Umesh Kumar Gaur, K. P. Sooraj, Mukesh Ranjan

Self-Organized Ordered Nanoparticles arrays for the SERS Applications
Sebin Augustine, Mahesh Saini, Sooraj KP, Mukesh Ranjan

International Symposium on Semiconductor Materials and Devices (ISSMD-2022), Kalinga Institute of Industrial Technology (KIIT), Bhubaneswar, 16-18 December 2022

Effect of thermal conductivity of gas used for sulfurization process on grain growth of CZTS thin film for solar cell application: Ar Vs. N2
Sagar Agrawal

IEEE 29th International Conference on High Performance Computing, Data, and Analytics (HiPC 2022), Bangalore, 18-21 December 2022

A Hands-on Approach for Scalable Parallel Applications Development: From Testbed to Petascale
Deepak Aggarwal

International Conference on Emerging Smart Materials in Applied Chemistry (ESMAC-2022), KIIT, Bhubaneswar, 20-22 December 2022

Milling effect on photocatalytic dye degradation using ZnO as catalyst
Rajashree Sahoo

NAARRI International Conference (NICSTAR-2023) on "Radiation Technologies: Challenges & Opportunities for Sustainable Development", Kochi, Kerala, 9-12 January 2023

IPR 14 MeV Neutron Irradiation Facility and its Proposed Utilization for Radiopharmaceuticals Research
H. L. Swami

National Conference on Emerging Trends in Vacuum Electronics Devices & Applications (VEDA-2022), Bengaluru, 19-21 January 2023

Large Volume Plasma Device - Upgrade: A Versatile plasma system for electron emitter, beam and wave based diagnostics
A. K. Sanyasi, P. K. Srivastava, Ayan Adhikari, L. M. Awasthi, and R. Sugandhi

Meeting with LIGO-India nodal institutes and LIGO-US personnel visiting IUCAA, at IUCAA, Pune, 6 March 2023

LI-VISTA Facility
S.Sunil

3rd International Conference on Advances in Plasma Science and Technology (ICAPST 2023), Sri Shakthi Institute of Engineering Technology, Coimbatore, 23-25 March 2023

Development of a Magneto-Optic Current Sensor (MOCS) diagnostic for plasma current measurements in ADITYA-U tokamak
Santosh P. Pandya, Kumudni Tahiliani, I. Suresh, Praveenlal E. V., Hrishikesh Kathale, Jahanvi Lalwani, Akash Shiroya, Sameer Kumar Jha, Lavkesh T. Lachwani, Suman Aich, Rohit Kumar, Surya Kumar Pathak, Rakesh L. Tanna, Joydeep Ghosh and ADITYA-U tokamak team

Assessment of stacked LSTM, Bidirectional LSTM, ConvLSTM2D and Auto encoders LSTM

time series regression analysis at ADITYA-U tokamak
Ramesh Joshi, J. Ghosh, Nilesh Kalani, R. L. Tanna and ADITYA/ADITYA-U Teams

Artificial Intelligence and its Applications in DAE Programmes, BRNS, DAE Convention Center, Anushakti Nagar, BARC, Mumbai, 31 March 2023

Artificial Intelligence (AI) based ongoing activities in IPR
Agraj Abhishek

AWARDS and ACHIEVEMENTS

Dr. Kishore Mishra, Dr. Lavkesh Lachhvani, Dr. Mainak Bandyopadhyay received the IOP 2021 Outstanding Reviewer Award for the year 2021 for the journal Plasma Physics and Controlled Fusion. Dr. Sarveshwar Sharma received the IOP 2021 Outstanding Reviewer Award for the year 2021 for the journal Plasma Science and Technology. (Notified in the Month of May 2022)

Dr. Arunsinh B. Zala who completed his PhD studies from HBNI - IPR was conferred upon with the J B Joshi Innovation Award 2022 by Homi Bhabha National Institute for his doctoral research work “Investigations on Weldability of Aluminide Coated 9cr Steel”. The award comprised of a citation and a cash prize of Rs. 25,000/-. This award is given to one student each year whose thesis work involves innovation driven approach to address an application. The nominations received are reviewed in a two-step process by a committee and the shortlisted candidates are interviewed through a presentation for final selection. The award was conferred upon to the awardee on HBNI Foundation Day, 3rd June 2022. The award was conferred upon Dr. Zala through the hands of Dr. A. V. Rama Rao, Founder & Managing Director - Avra Laboratories Pvt. Ltd. and Former Director - IICT Hyderabad.

Mr. Ankit Gandhi received Consolation Prize award for his presentation on “Optimization of Circulation Power in First Wall of Breeding Blanket using He-CO2 Gas Mixture as a Replacement of Helium” at 8th International Conference on Advances in Energy Research (ICAER), Indian Institute of Technology Bombay, Mumbai, 7-9 July 2022. [Co-auhtors: Nimesh Gajjar, Paritosh Chaudhuri]

Ms. Sukiriti Hans, gave a talk on "Role of Ion Beam Parameters in the Evolution of Self-organized Nanoripple Superimposed by Triangular Features" and received the Best Oral Presentation Award under Young Research Award category, at the 22nd International Conference on Ion Beam and Materials Modifications (IBMM-22), Lisbon, Portugal, 10-15 July 2022.

Mr. Mizanur Rahman, received Best oral presentation (3rd) Prize award for his presentation on “High-rate Synthesis of Stoichiometric and Hydrogenated Molybdenum-oxide Nanomaterials by One-step Plasma Techniques, for Dye Adsorption and Treatment of Cancer” at the National Conference on Recent Developments and Evolving Trends in Plasma Science and Technology & Preconference Workshop on Modelling and Simulation of Industrial Plasmas, jointly organized by Department of Physics Bharathiar University, Coimbatore and Beam Technology Development Group, Bhabha Atomic Research Centre (BARC), Mumbai in association with the Power Beam Society of India (PSI), Navi Mumbai, during 22-24 September 2022

Mr. Ankit Dhaka, received Best Poster-III award for his poster presentation on "Experimental Estimation of Transport Parameters using Microscopic Density Fluctuations of Dusty Plasmas" at the National Conference on Recent Developments and Evolving Trends in Plasma Science and Technology & Pre-conference Workshop on Modelling and Simulation of Industrial Plasmas, jointly organized by Department of Physics Bharathiar University, Coimbatore and Beam Technology Development Group, Bhabha Atomic Research Centre (BARC),

Mumbai in association with the Power Beam Society of India (PSI), Navi Mumbai, during 22-24 September 2022

Mr. Piyush Raj, received Best Paper Award for his poster presentation on "Development of Lab Scale Conduction Cooled HTS Magnets" at the 28th National Symposium on Cryogenics and Superconductivity (NSCS-28), IIT Kharagpur, 19-21st October 2022

Mr. Vishal Gupta, received Best Paper Award for his poster presentation on "Development of Cryopump to evacuate large throughput under high heat load condition for SST-1" at the 28th National Symposium on Cryogenics and Superconductivity (NSCS-28), IIT Kharagpur, 19-21st October 2022

The IPR exhibition stall received the award for the "Stall with the Best Exhibits" from Shri Devji Patel, (MP, Jalore-Sirohi), who earlier visited the IPR stall and interacted with the IPR staff at the "Vison Rajasthan-2022" Exhibition at Sirohi, Rajasthan, 1-3 November, 2022

Mr. Aroh Shrivastava received Best Poster Award for his poster entitled "Estimation of porosity-thermal conductivity relationship of compact LiTiO3 ceramic" at 23rd DAE-BRNS Symposium on Thermal Analysis (THERMANS-2022), which was held at the Khalsa College, Amritsar, 3-5 November 2022

Dr. Pintu Bandyopadhyay, gave a talk on "Experiments in Complex Plasmas" at 37th National Symposium on Plasma Science & Technology (Plasma-2022), Plasma Science Society of India (PSSI) and the Indian Institute of Technology, Jodhpur, 12-14 December 2022, and have received Jaidutt Saraswati Sodha PSSI Plasma Award

Mr. Dheeraj Kumar Sharma, gave a talk on "Manufacturing Experience of Indigenously Developed Dished Head-Sub Assembly (DH-SA) for High Voltage Bushing (HVB) of Indian Test Facility (INTF)" at 37th National Symposium on Plasma Science & Technology (Plasma-2022), Plasma Science Society of India (PSSI) and the Indian Institute of Technology, Jodhpur, 12-14 December 2022, and have received First prize of the "PSSI- Z.H. Sholapurwala Award for Fusion Research

Ms. Praveena kumari, gave a talk on "Implementation of Drift Free Integrators for Tokamak" at 37th National Symposium on Plasma Science & Technology (Plasma-2022), Plasma Science Society of India (PSSI) and the Indian Institute of Technology, Jodhpur, 12-14 December 2022, and have received Second prize of the "PSSI-Z.H. Sholapurwala Award for Fusion Research"

Mr. Shishir Biswas, gave a talk on "Effect of flow shear on the onset of dynamo" at 37th National Symposium on Plasma Science & Technology (Plasma-2022), Plasma Science Society of India

(PSSI) and the Indian Institute of Technology, Jodhpur, 12-14 December 2022, and have received PSSI Best Poster Award 2022

Mr. Jaydeep Joshi (ITER-India) has been adjudged as the Winner of the Fronius India Best Welding Engineer Competition for the year 2022. The award received at the Inaugural Session of the National Welding Seminar 2022 held on 19th of January, 2023 at Chennai Trade Centre, Nandambakkam, Chennai. This competition had three round of selection process. First was online screening test consisting of two sections, wherein ~500 engineers have participated across India / engineers working abroad with Indian origin. Out of 500, 10 were shortlisted for next round with was an online interactive session with the Indian Institute of Welding panel. Out of 10, 4 were selected for the final round of online group discussion.

E. 4 INVITED TALK DELIVERED BY IPR STAFF

P. VADIVEL MURUGAN

Gave an invited talk on "Thermal Plasma for Industrial Waste Management" at a webinar on Waste to Wealth: Towards $ 5 trillion economy, MS University, Baroda, on 4th April 2022

S.S. KAUSIK

Gave an invited talk on “An Overview of Dust Charging to Negative Ions in Plasma @ CPP-IPR” at a National Conference on Physical Sciences-2022 (NCPS-2022) organized jointly by the Dept. of Physics, DHSK College, Dibrugarh & Dept. of Physics, Manipur University, Manipur, 30th April 2022

RAKESH MOULICK

Gave an invited talk on "Fundamentals of Plasma Theory and Simulation" at a Workshop on Basic Plasma Physics, Dept. of Physics, Assam Don Bosco University, Assam, 6th May 2022

SARVESHWAR SHARMA

Gave an invited talk on "Plasma: Key tool for energy production and industrial applications" at Delhi Public School (DPS), Gandhinagar, Gujarat, 20th August 2022

Gave an invited talk on “Electron bounce-cyclotron resonance in capacitive discharges at low magnetic fields” at 2nd International Conference on Plasma Theory and Simulations (PTS–2022), University of Lucknow, 20-22nd June 2022

Gave an invited talk on "Electron bounce-cyclotron resonance in capacitive discharges at low magnetic fields" at 15th Asia Pacific Plasma Conference (APPC15-2022), Association of Asia Pacific Physical Societies (AAPPS) and the Korean Physical Society (KPS), South Korea, 22-26th August 2022

Gave a Keynote address on the topic “Global gyrokinetic simulations of electrostatic microturbulence transport using kinetic electrons in LHD heliotron" at International conference on Numerical Simulation of Plasmas (27th ICNSP2022), Nagoya University, Nagoya, Japan, 30th August-2nd September 2022 [Co-authors: Tajinder Singh, Javier H. Nicolau, Zhihong Lin, Sarveshwar Sharma, Abhijit Sen, and Animesh Kuley]

Gave a Keynote address on the topic "Plasma: A Key tool for energy production and industrial applications" at IEEE ESTC’22-Evolving Science and Technology Convention, Birla Vishvakarma Mahavidyalaya Engineering College, Vallabh Vidyanagar, Gujarat, 11th September 2022

Gave an invited talk on “Investigating the effects

of electron bounce-cyclotron resonance on plasma dynamics in capacitive discharges operated in the presence of a weak transverse magnetic field" at 6th Asia-Pacific online Conference on Plasma Physics (AAPPS-DPP2022), Division of Plasma Physics, Association of Asia-Pacific Physical Societies, 9-14th October 2022. [Co-authors: S. Patil, S. Sengupta, A. Sen, A. Khrabrov, I. D. Kaganovich]

JAYDEEP JOSHI

Gave an invited talk on "Dissimilar Material Welding for Nuclear Fusion Application Challenges, Experience and the way forward" at DAE-BRNS Theme Meeting on Advance Technologies in Dissimilar Metal Welding (DMW-2022) and DAE Technology Awareness Meet-II, Anushakti Nagar, Mumbai, 15-16th July 2022

PINTU BANDYOPADHYAY

Gave an invited talk on "Experiments on complex plasma crystal in a DC glow discharge plasma" at DAE Condense Matter Physics Meet organized by HBNI, DAE Mumbai and SINP, Kolkata, 23-24th June 2022

MUKESH RANJAN

Gave an invited talk on "Surface Modifications Using Low Energy Ions: Experiment and Theory" at DAE Condense Matter Physics Meet organized by HBNI, DAE Mumbai and SINP, Kolkata, 23-24th June 2022

Gave an invited talk entitled "Low Energy Ion Produced Nanostructuring for Surface Wettability and Sensing Applications in Healthcare" at the 22nd International Conference on Ion Beam and Materials Modifications (IBMM-22), Lisbon, Portugal, 10-15th July 2022

Gave an invited talk on "Plasma Ion Sources from Space Research to Material Science" at Recent Developments in Plasma Based Ion Sources for Accelerators and Associated Physics, IUAC, New Delhi, 16-17th August 2022

Gave an invited talk on "Harnessing Plasmas for Societal Applications" at a National Conference on Advances in Physical Sciences for Sustainable Development (NCAPSSD-2022), Indian Institute of Teachers Educations (IITE), Gandhinagar, 27th August 2022

SUDHIR KUMAR NEMA

Gave an invited talk on "Plasma based Technologies for Healthcare & Medical Applications" at Institute of Pharmacy and Institute of Science, Nirma University, Ahmedabad, 4th July 2022

Gave an invited talk on "Current status of plasma-assisted disposal of hazardous and infectious wastes and future opportunities" at Indo-German Centre for Sustainability (IGCS), IIT Madras, 22nd July 2022

Gave a keynote address on the topic "Advance Plasma Based Technologies for Solving Environmental Issues" at National Seminar on Current Trends in Environment Sciences: Issues and Challenges, National Forensic Sciences University, Gandhinagar, on 19th October 2022

Gave an invited talk on "Energy Recovery from Organic Waste using Thermal Plasma Technology" at International e-Symposium on Plasma for Energy (ISPE-2022)" SRMIST, Tamil Nadu, 5-6 December 2022

Gave a plenary talk on "Plasma Activated Water and its Potential Applications as Antimicrobial & Anti-fungal Reagent and in Agriculture Field"

at 3rd International Conference on Advances in Plasma Science and Technology (ICAPST 2023), Sri Shakthi Institute of Engineering Technology, Coimbatore, 23-25 March 2023

RAJESHKUMAR G. TRIVEDI

Gave an invited talk on "The Indigenous development of high power RF amplifiers and RF Transmission line components for scientific application" at a Meeting on Indigenous development of RF Power Sources & Amplifiers for Accelerators, IUAC Campus, New Delhi, 3rd August 2022

SATYA PRAKASH REDDY KANDADA

Gave an invited talk on "Nanomaterials activity at Institute for Plasma Research, India" at University of Toyama, Toyama, Japan, 10th August 2022

N. I. JAMNAPARA

Gave an invited talk on "Innovations in Engineering" at Vishwakarma Goverment Engineering College, Chandkheda, 05th September 2022

Gave an invited talk on "Materials characterization techniques" at STTP programme on "Processing & characterization of materials (PCM 2022)" organized by Government Engineering college, Gandhinagar, 21st September 2022

Gave an invited talk on "Innovation & Intellectual Property Rights" at Government MCA College, Ahmedabad, 23rd September 2022

Gave an invited talk on "On plasma assisted diffusion aluminide coatings for Ni-based superalloys" at International Conference on Materials Engineering & Technology and Advances in Heat Treatment (MET + HTS 2022), organized by ASM International India Chapter, Mumbai, 2-4 November 2022 [Co-authors: Arunsinh B. Zala]

A V RAVI KUMAR

Gave an invited talk on "Plasma - Mankind's New Tool" at "2022 Physics Alumni Colloquium: 50th year celebrations of the Department of Physics, CUSAT", Cochin University of Science & Technology, Kochi, 15th September 2022.

DEEPAK AGGARWAL

Gave an invited talk on "How IPR's Scientific Pursuits Being Augmented by HPC Simulations" at the Altair Technology Conference 2022 (ATC-2022) on Convergence of Simulation, HPC and AI held at Pune, Maharashtra, 16th September 2022

SWAPNALI KHAMARU

Gave an invited talk on "A novel quiescent quasi-steady toroidal electron cloud in a 3D toroidal trap with end-plugs" at 13th International Workshop on Non-Neutral Plasmas, Milano, Italy, 19-22nd September 2022

PRATIK PATEL

Gave an invited talk on "Basics of Fusion energy and use of Cryogenics system in ITER project" at Shri Labhubhai Trivedi Institute of Engineering & Technology (SLTIET), Rajkot, 21st September 2022

N. RAMASUBRAMANIAN

Gave an invited talk on "Lighting up the Dark Plasma and Generating the Decoded Information" at National Conference on Recent Developments and Evolving Trends in Plasma Science and

Technology & Pre-Conference Workshop on Modelling and Simulation of Industrial Plasmas, Bharathiar University, Coimbatore, on 22-24 September 2022

AMREEN A. HUSSAIN

Gave an invited talk on "Development of Hybrid Material Based Optoelectronic Devices by Plasma Technologies" at Symposium on Nano Science and Plasma based Technologies, Department of Physics, Assam Don Bosco University, 24th September 2022

RAJESHKUMAR G. TRIVEDI

Gave an invited talk on "Outcome of R&D phase and performance test results of inhouse developed associated components/subsystems for ITER prototype RF source" at 24th Topical Conference on Radio-frequency Power in Plasma, Massachusetts Institute of Technology Plasma Science and Fusion Center, USA, 28th September 2022

RAJARAMAN GANESH

Gave a plenary talk on "Can a toroidal electron plasma be confined for ever - a numerical exploration!" at 6th Asia-Pacific online Conference on Plasma Physics (AAPPS-DPP2022), Division of Plasma Physics, Association of Asia-Pacific Physical Societies, 9-14 October 2022. [Co-authors: Swapnali Khamaru, Meghraj Sengupta]

SHISHIR DESHPANDE

Gave an invited talk on "Nuclear Fusion: Indian Program, ITER Project & Beyond", at PRL ka Amrut Vyakhyaan, as a part of PRL 75 Years Celebrations, 12th October 2022

ARUN CHAKRABORTY

Gave an invited talk on "Role of Ion Sources in Fusion Devices" at 25th International Workshop on Electron Cyclotron Resonance Ion Sources 2022 (ECRIS-2022), Institute for Plasma Research, Gandhinagar, 12-14 October 2022

Plenary and Invited talks given at 28th National Symposium on Cryogenics and Superconductivity (NSCS-28), IIT Kharagpur, 19-21st October 2022

SHASHANK CHATURVEDI gave a plenary talk on "Cryogenics and Superconductivity for Fusion & Plasma Research in India: Status and Future Needs"

PRATIK M PATEL gave an invited talk on "Indian contributions and achievement in cryogenics systems of the ITER project"

UPENDRA PRASAD gave an invited talk on "The Development of Superconducting Magnet Technology for Tokamak Magnets: R&D update and plan"

RANJANA GANGRADEY gave an invited talk on "Cryopump Development at Institute for Plasma Research, India"

ANANTA KUMAR SAHU gave an invited talk on "Development of Indigenous Helium Refrigerator Plant at IPR: Present Status"

SHASHANK CHATURVEDI gave an invited talk on "Fusion and Plasma Research in India: Where are we, where are we going?" at the 67th "PRL ka Amrut Vyakhyaan" on 9th November 2022. In his talk, Dr. Chaturvedi introduced the topic of plasma, briefly described some of the applications of plasma being pursued at IPR as well as India's contributions to the ITER programme. He also

touched upon the 25-year plasma & fusion R&D roadmap for India.

SEJAL SHAH gave an invited talk on "ITER: A Step to Harness Safe and Clean Energy & Material Challenges under Radiation" at Energy Summit, 2022, University of Petroleum & Energy Studies, Dehradun, 23th November 2022

RENU BAHL gave an invited talk on "Plasma Thruster Activities at IPR" at Plasma for Space and Aerospace Applications, IPR, Gandhinagar, 24-25 November 2022. [Co Author: Prabal K Chattopadhyay, Buddu Ramesh, Narender Singh, Mariammal Megalingam, Mritunjay Kumar, Sunil Kumar, Rana Pratap Yadav]

Plenary and Invited talks given at 37th National Symposium on Plasma Science & Technology (Plasma-2022), Indian Institute of Technology, Jodhpur, 12-14 December 2022

S.P. DESHPANDE gave a plenary talk on "Harnessing Nuclear Fusion: India's ITER Participation and Fusion Roadmap"

SUDIP SENGUPTA, gave an invited talk on "Radiation reaction effects on charged particle dynamics in an intense electromagnetic wave"
DANIEL RAJU gave an invited talk on "Diagnostics: Tokamak Operator's Perspetive"

PINTU BANDYOPADHYAY, gave an invited talk on "Experiments on crystal dynamics in strongly coupled complex plasmas"

MAYUR MEHTA gave an invited talk on "Neutron cross-section studies for Fusion-Fission reactor materials" at International Indo-Czech Christmas Workshop in Applied Nuclear Physics, Education and Data Measurement (InCzechNuc2022), Brno University of Technology, Faculty of Electrical Engineering, Brno, Czech Republic, 21st December 2022. [Co-authors: N.L. Singh, P.V. Subhash, R. Makwana, R. Chauhan, Ratankumar Singh, Karel Katovsky]

Invited talks given at 15th International Conference on Plasma Science and Applications (ICPSA2022), organized by Gauhati University (GU) and Asian African Association for Plasma Training (AAAPT), 28-30 December 2022

RAKESH MOULICK gave an invited talk on "Particle-In-Cell simulation of electrostatic waves in the ionosphere"

NGANGOM AOMOA gave an invited talk on "Characterization of a DC atmospheric pressure air discharge and its application in waste water treatment"

MAYUR KAKATI gave an invited talk on "A novel plasma technique for very high rate synthesis of multifunctional metal-oxide nanomaterials"

RAJIV SHARMA gave an invited talk on "Experience with Cryogenics, High Pressure Safety, Problems and Solutions" at 2nd DAE BRNS Workshop on Cryogenic Facility Management, Organized by DAE BRNS, TIFR Mumbai, 4-7 January 2023

VISHAL JAIN gave an invited talk on occasion of "Swachhata and Health" at a half day seminar at BARC, Mumbai, on 28th February 2023

E.5 TALKS DELIVERED BY DISTINGUISHED VISITORS AT IPR

Dr. Poonam Gawali, University of Bombay, Maharashtra, gave a talk on "Flavonoid mediated

gold and silver nanoparticle's synthesis and characterization and checked the efficacy by antioxidant, anti-inflammatory, and anticancer activities" on 01st April 2022

Dr. Dhyey Raval, PDPU, Gandhinagar, gave a talk on "Development of plasma process based photoelectrode and process control applications" on 08th April 2022

Dr. Supriya More, Savitribai Phule Pune University, Pune, gave a talk on "Plasma-surface: Interaction, Optimization and Applications" on 22nd April 2022

Dr. Ipsita Das, Indian Institute of Technology, Kharagpur, gave a talk on "Design aspects of High-Temperature Superconducting (HTS) power cables" on 29th April 2022

Dr. Nishanth Katam, Indian Institute of Science, Bangalore, gave a talk on "Plasma Catalysis for NOx and THC Removal using Industrial Wastes" on 06th May 2022

Dr. Kajal Garg, Dayalbagh Educational Institute, Agra, gave a talk on "Impact of Cosmic Rays in Real Life" on 13th May 2022

Dr. Rahul Awathankar, VFSTR University, Guntur, Andhra Pradesh, gave a talk on, "To design and develop IoT based smart automation system for industry" on 3rd June 2022

Dr. Arun Kumar, Anna University, Chennai, gave a talk on "Surface modification of polymeric materials using glow discharge plasma" on 17th June 2022

Dr. Asha Panghal, M. S. University of Baroda, Vadodara, gave a talk on, "Radiation-induced structural modifications and radiation tolerance in pyrochlore oxides" on 24th June 2022

Dr. Gajendar Singh, Central University of Gujarat, Gandhinagar, gave a talk on" Designing of metal molybdates/chalcogenides and graphene-based nanocatalysts for the advancement of sensing and overall water splitting applications" on 8th July 2022

Dr. Varun Dixit, CSIR - CEERI, Pilani, Rajasthan, gave a talk on "Design and Development Studies of Pseudospark Discharge based Plasma Cathode Electron Source for High Density and Energetic Electron Beam Generation for Pulsed Power Applications" on 22nd July 2022

Dr. Amarish Kumar Shukla, Indian Institute of Technology, Kharagpur, gave a talk on "Metallurgical Characteristics, Porosity, Compressive Strength, Wear, and Chemical Degradation Behaviour of Aluminium-Cenosphere Composite Foam" on 26th August 2022

Dr. Miral Shah, DA-IICT, Gandhinagar, gave a talk on "Computational Characterization of plasma transport in low temperature ExB plasmas using 2D-3V PIC-MCC simulations" on 9th September 2022

Dr. Shiva Kumar Malapaka, IIIT-Bangalore, gave a talk on "Power laws, Spectral Relation and Large-scale Magnetic Structure Formation in Helically Forced and Decaying 3D-MHD Turbulent Flows at various Magnetic Prandtl numbers" on 22nd September 2022

Dr. Amit Kumar Rana, Ulsan National Institute of Science and Technology (UNIST), Ulsan, South Korea, gave a talk on "Semiconductor Oxides: From Materials to Applications" on 23rd September 2022

Dr. Nitin Kumar Sharma, Indian Institute of Technology (IIT) Jodhpur, gave a talk on "Microstructural engineering across length scales in structural alloys" on 30th September 2022

Dr. Oriza Kamboj, Lovely Professional University, Jalandhar, gave a talk on "Instabilities and Burn Analysis in context to Inertial Confinement Fusion" on 18th October 2022

Dr. A. Sivathanu Pillai, Distinguished Scientist, Founder-CEO and MD of BraMos Aerospace, gave a talk on
"Futuristic Technologies: Vision, Strategy & the Art of Project Execution" on 19th October 2022

Dr. Margi Jani, Pandit Deendayal Energy University, Gandhinagar, gave a talk on "Optimizing thin-film based buffer layer and transparent conducting oxides performance for device applications" on 28th October 2022

Dr. Raj Jadav, University of Queensland, Australia, gave a talk on "Condition Evaluation of Transformer Insulation Using Polarisation Based Method" on 28th November 2022

Dr. Abhinav Jain, Tel Aviv University, Israel, gave a talk on "Development of mock-up RF matching network for ICRH system of Tokamak and its optimization with continuously variable load" on 30th November 2022

Dr. Gaurav Saxena, Delhi Technological University, New Delhi, gave a talk on "Design and Analysis of Microwave Components for Mimo Communication System" on 9th December 2022

Dr. Nilamani Sahoo, IIT Ropar, Punjab, gave a talk on "Ferro and electrohydrodynamics of impacting droplets" on 16th December 2022

Professor K. Avinash, Central University Sikkim, gave a talk on "A New Acoustic Mode" on 21st December 2022

Dr. Arun Pandey, Max Planck Institute of Plasma physics, Greifswald, Germany, gave a talk on "Stable, small plasmas in Wendelstein 7-X" on 27th December 2022

Dr. Mamta Rao, Malaviya National Institute of Technology, Jaipur, gave a talk on "Nonlinear Laser Interaction with Nanoparticles, Nanotubes and Plasmas" on 6th January 2023

Dr. Sarvesh Kashyap, Indian Institute of Technology (BHU) Varanasi, gave a talk on "Numerical and experimental studies on evaporative cooler" on 20th January 2023

Dr. Nancy Verma, Raman Research Institute, Bengaluru, gave a talk on "Laser Ablation and Surface Structuring of Selected Solid Targets" on 3rd February 2023

Dr. Prashant Kumar, IIT Delhi, gave a talk on "Investigations on the effect of plasma boundary and electrode asymmetry on plasma behavior in planar DC discharges" on 28th February 2023

Dr. Dipak Bhowmik, IIT Kanpur, gave a talk on "Nano ripple patterning and band gap tailoring of muscovite mica sheet using plasma based ultra-low and low energy ion sputtering" on 3rd March 2023

Dr. Debajyoti Ray, Bose Institute, Kolkata, gave a talk on "Towards the Development of a Novel Destruction Approach of Volatile Organic Compounds (VOCs) Using Non-Thermal Plasma Coupled with Heterogeneous Catalysts" on 17th

March 2023

Dr. Gajendra Singh, Guru Gobind Singh Indraprastha University (GGSIPU), Dwarka, gave a talk on “Spectroscopy of highly charged ions significant to astrophysics and laboratory plasma diagnostic studies” on 31st March 2023

E.6 COLLOQUIA PRESENTED AT IPR

Prof. Parthasarathi Ghosh, Indian Institute of Technology, Kharagpur, gave a talk on “Research activities at PED laboratory, Cryogenic Engineering Centre” on 31st May 2022 (Colloquium #314)

Dr. Surojit Gupta, Department of Mechanical Engineering, University of North Dakota, gave a talk on “On the synthesis and characterization of novel composites for multifunctional applications” on 25th July 2022 (Colloquium #315)

Dr. Indira Nityanandam, Principal (Retd.), Smt. S.R. Mehta Arts College, Ahmedabad, gave a talk on "Towards centenary celebrations" on 25th August 2022 (Colloquium #316)

Dr. Surendra Pal, Retired Vice-Chancellor of Defense Institute of Advanced Technology (DIAT), Pune, DRDO, gave a talk on "Indian GNSS Paradigm and international trends" on 26th August 2022 (Colloquium #317)

Prof. Swadesh Mahajan, Institute for Fusion Studies, The University of Texas at Austin and Adjunct Professor at the Shiv Nadar University, Delhi, gave a talk on "Why and How of Transport Barriers-Advancing Nuclear Fusion: An examination through dynamic constraints and basic notions of statistical mechanics" on 6th December 2022 (Colloquium #318)

Prof. Radha Bahukutumbi, Laboratory for Laser Energetics University of Rochester, Rochester, NY, gave a talk on "Inertial Confinement Fusion: Overview, Status, and Path Forward" on 9th February 2023 (Colloquium #319)

Dr. Kailash C Mittal, Retired Senior Scientist, BARC, Mumbai, gave a talk on "High Intensity Low Energy Electron Accelerators for Sub Critical Micro Nuclear Reactors" on 23rd February 2023 (Colloquium #320)

Prof. Jean-Philippe Ansermet, Honorary Professor, Ecole Polytechnique Fédérale de Lausanne, Switzerland, gave a talk on "Gyrotrons for Nuclear Magnetic Resonance high-performance spectrometers" on 2nd March 2023 (Colloquium #321)

Dr. Prasad Perlekar, TIFR Centre for Interdisciplinary Sciences, Hyderabad, gave a talk on "Turbulence in buoyancy-driven bubbly flows" on 17th March 2023 (Colloquium #322)

Mr. Robert Pearce, ITER Organization, France, gave a talk on "Progress in the Realisation of ITER Vacuum Systems and Maintaining Vacuum Quality" on 22nd March 2023 (Colloquium #323)

E.7 SCIENTIFIC MEETINGS HOSTED BY IPR

Outreach Activities @ IPR (April-May 2022)

IPR has now started allowing campus visits as part of students’ academic programme after a gap of over two years. On 1st April 2022, 22 students of B. Tech (Metallurgical) Department from Indus College of Engineering, Ahmedabad, visited FCIPT Campus, IPR. On 4th April 2022, 9 B.Ed. (Science) students and 1 Faculty member

of Indian Institute of Teacher's Education (IITE), Gandhinagar, visited FCIPT Campus, IPR. On 5th April 2022, 7 Delegates from the Gujarat Power Research & Development Cell visited FCIPT for exploring solutions /collaborations for resolving power sector related problems, viz, specialized coatings, materials, HV insulation corrosion etc. On 20th April 2022, 32 B. Tech students and 2 faculty members of Prakalpa Science Club of LD College of Engineering, Ahmedabad, visited IPR.

As part of the AKAM celebrations, IPR has been conducting a series of scientific outreach activities in rural schools of different districts of Gujarat. The second such event was conducted during 22nd-29th April, 2022 at the Vasishtha Vidhyalaya, Vav Village, Kamrej Taluka, Surat. This is a Gujarati /English medium school with over 7000 students studying in classes 1-12. The IPR exhibition on plasma was visited by students from 8-12 standard of both English and Gujarati medium sections.

The 4-day event consisted of a popular talk on plasma and its applications and exhibition of over 15 working models related to plasma and its applications. Over 1000 students of the host school as well students from nearby schools in this taluka visited the exhibition. As part of the event, the Gujarati version of the children's comic book on plasma "The Wonderful World of Plasma" was also distributed to all the participating students and teachers. A set of 10 posters on plasma and a popular book on plasma "Living with Plasma" were also distributed to the visiting schools for display in their school's library. IPR Outreach proposes to conduct such events in rural schools of Bhuj and Banaskantha districts in the coming months.

On 11th May 2022, 54 students of +2 standard of Indo Science Education Trust, Pune, visited IPR. On 18th May 2022, 25 students and 2 teachers from Silver Oak Institute of Science, Ahmedabad, and 29 student participants of YUVIKA programme of SAC-ISRO and 4 coordinators visited IPR

Workshop on Intellectual Property Rights

IPR has been developing technologies for fusion as well as for societal benefits. To secure such knowledge, IPR has been actively securing the Intellectual Property by way of patents, designs, copyrights and trademarks. Considering the utilization of knowledge for present and future, World Intellectual Property Organization (WIPO) had emphasized on Youth by celebrating 26th April 2022 on the theme "IP and Youth: Innovating for a better future". IPR had also been planning to organize a workshop on IP awareness amongst its employees, especially young researchers. Considering the need and with the support of DAE patent cell, IPR had organized a one day workshop on Intellectual Property Rights on 12th May 2022 at IPR, Bhat, Gandhinagar. The programme was attended by over 60 participants from the Institute. Dr. Paritosh Chaudhury, chairman-TTIP committee welcomed the guests and Dr. Shashank Chaturvedi, Director-IPR delivered the welcome note. The talks by speakers included talks on introduction to IP, Patenting, Journey of patent to technology by Mrs. Anuradha Maheshwari, Founder - LexMantis, on Tech transfer by Dr. Nirav Jamnapara and on DAE experience with patenting by Shri P R Dani, Member Secretary - DAE IPR Cell. The event was ended with vote of thanks by Mr. Saroj Das, Member Secretary TTIP committee. During the workshop, it was suggested that such workshops should be conducted every year, which the TTIP committee noted for further consideration.

AKAM National Technology Day-2022

As part of the Azadi Ka Amrut Mahotsav, IPR and the L. D. College of Engineering, Ahmedabad jointly organized a 2-day event during 5-6th May, 2022 to celebrate the National Technology Day.

The event was organized by the "Prakalpa" Science Club of LDCE, at the EC Department, LDCE Ahmedabad and had the following competitive events; Poster Competition; Technology Quiz; Skit Competition; Science/Technology models by UG students of engineering colleges; Circuit design; Circuit debugging competition

Apart from the above mentioned competitions, the event also has two popular talks, "Technologies from Plasma Science: Present day and Future" delivered by Dr. Shashank Chaturvedi and "Immersive and interactive visualization" delivered by Shri. Kandrap Pandya, SAC-ISRO, Ahmedabad on 5th and 6th May respectively. IPR Outreach also organized an exhibition on plasma, its applications and nuclear fusion which was organized by Outreach Division. Selected members of Prakalpa Science Club were trained by IPR Outreach staff to explain all the exhibits to the visitors during the event. Over 67 UG engineering students from 9 engineering colleges across Gujarat participated in the various competitive events and over 2000 students from LDEC and other engineering colleges in Ahmedabad visited the IPR exhibition over the two days.

Training Program for Science Communicators of Gujarat's Regional Science Centers

As part of the AKAM celebrations, IPR plans to conduct several scientific outreach activities in rural Gujarat. In view of this, IPR, in collaboration with the Gujarat Council on Science and Technology (GUJCOST) conducted a training programme for science communicators of the various Regional Community Science Centers of Gujarat State. Thirty four science communicators from CSC's and other educational institutions in Gujarat (28 male and 6 female communicators) attended this two-day programme that was held at IPR during 12-13th May, 2022. This programme envisages to train the science communicators in plasma & its applications so that IPR can hold scientific outreach activities in more rural areas of the state with the help of Regional Science Centers. The programme had popular lectures and hands-on experiments as well as extended Q&A sessions that were held in the Outreach Hall at IPR. The participants also visited several laboratories in IPR and FCIPT and were provided resource materials to help them propagate the science of plasma through their centers. Certificates were also provided to all the participants. The programme was inaugurated by Dr. Shashank Chaturvedi, Director, IPR and Dr. Narottam Sahoo, Advisor, GUJCOST. During his address Dr. Chaturvedi urged the participants to highlight the various applications of plasma when they conduct programs at their regional centers.

Academic Visits to IPR
(Campus visits to IPR/FCIPT in the month of June 2022)

On 10th June 2022, 46 students of B.Sc and M.Sc integrated course and 2 faculty members from National Forensic Science University, Gandhinagar, visited IPR/FCIPT and on 29th June 2022, 55 students of 11-12 standard and 3 faculty members from Mahatma Gandhi International School, Ahmedabad, visited IPR/FCIPT.

AKAM Rural Outreach Program @ Thara, Banaskantha

As part of the AKAM celebrations, IPR has been conducting a series of scientific outreach activities in rural schools of different districts of Gujarat. The third such event was conducted during 20-24th June, 2022 at the Akshargyan Vidya Mandir, Thara, Kakrej Taluka, Banaskantha. This is a Gujarati medium school with over 650 students studying in classes 1-12. The 4-day event consisted of popular talks on plasma and its applications and exhibition

of over 15 working models. Over 450 students and teachers from this school as well as around 700 students from nearby schools and colleges in this taluka and general public visited the exhibition. A highlight of this programme was that around 20 students of 10th standard were trained to explain the exhibits to the visitors. As part of the event, the Gujarati version of the children's comic book on plasma "The Wonderful World of Plasma" was also distributed to all the visiting students and teachers. A set of 10 posters on plasma and a popular book on plasma "Living with Plasma" were also distributed to the visiting schools for display in their school's library. IPR Outreach proposes to conduct such events in rural schools of Amreli and Bhuj districts of Gujarat in the coming months.

International Yoga Day @ IPR

The International Yoga Day (IYD) was celebrated by IPR Staff Club on 21st June 2022 at the IPR Guest during 7:15 to 08:30 AM. Yoga Guru, Ms. Vipula Pradhan of Art of Living Foundation, was invited to conduct yoga session for IPR staff members at the lawns of the Guest House. Shri Niranjan Vaishnav (CAO) welcomed the IPR staff and he highlighted the role of yoga in post-covid world. After the yoga session, the program concluded with light refreshments. As a part of the IYD, T-shirts were distributed to the staff members and a poster competition entitled "Yoga and You" was organized to spread the awareness of Yoga.

IPR @DAE-Condensed Matter Physics Meeting

HBNI organized a focused meeting on Condensed Matter Physics at SINP, Kolkata on 23-24th June 2022. The primary objective of the meeting was to improve mutual interaction and collaboration among DAE institutes and utilise existing facilities. The meeting was inaugurated by Dr. Gautam Bhattacharyya (Director, SINP) and Dr. P. R. Vasudeva Rao (VC, HBNI). From IPR, Dr. Pintu Bandyopadhyay and Dr. Mukesh Ranjan attended the meeting.

Technical/Scientific Activities of Department of Atomic Energy

Hindi Webinar on Technical/Scientific Activities of Department of Atomic Energy was organised at IPR, Gandhinagar, 23-24th June 2022

AKAM Rural Outreach Program @ Varasda, Amreli

As part of the AKAM celebrations, IPR has been conducting a series of scientific outreach activities in rural schools of different districts of Gujarat. The third such event was conducted during 4-8th July, 2022 at the Kalam Innovative School, located at Varasda Village in Amreli district. This is a Gujarati medium school with over 350 students studying in classes 1-10. The 4-day event consisted of popular talks on plasma and its applications and exhibition of over 15 working models. Over 4000 students and teachers from 9 schools in the vicinity as well as general public visited the exhibition. Students from the local school for deaf and mute students also attended the exhibition, which was a unique experience for IPR Outreach. Students of class 10 from the host school were trained to explain the exhibits to the visitors.

As part of the event, the Gujarati version of the children's comic book on plasma "The Wonderful World of Plasma" was also distributed to all the visiting students and teachers. Students from the school were trained to explain the exhibits to visitors. A set of 10 posters on plasma and a popular book on plasma "Living with Plasma" were also distributed to the visiting schools for display in their school's library. IPR Outreach proposes to

conduct such events in rural schools of Mandvi, Bhavnagar and Porbandar Districts of Gujarat in the coming months.
Such scientific outreach activities in rural schools of Gujarat is aimed at exposing the students and teachers to the field of plasma, its applications and the possibility of production of energy using magnetically confined fusion. Such events also highlight the activities of IPR, FCIPT, ITER-India as well as CPP-IPR in the area of plasma science & technology.

AKAM Outreach Activities @ CPP-IPR (April-July 2022)

Centre of Plasma Physics- Institute for Plasma Research has taken several initiatives for various outreach activities to disseminate plasma physics across the north- eastern part of the country under the auspices of "Azadi Ka Amrit Mahotsav". Through its outreach programmes, CPP-IPR has been able to promote interest in plasma as well its applications among the students at some of the most remote institutions of the region. Personnel from the CPP-IPR have visited Tezpur University, Tezpur, Assam (on 08/04/2022) and Don Bosco College, Tura, Meghalaya (on 12/04/2022), DHSK College, Dibrugarh (on 21/06/2022), Dibrugarh University (22/06/2022), Tinsukia College, Tinsukia (on 23/06/2022) and St. Anthony's College, Shillong (on 18/07/2022). Dr. Bipul Jyoti Saikia, Dr. N. K. Neog, Dr. S. S. Kausik, Dr. Ngangom Aomoa and Dr. Rakesh Moulick were involved in the outreach activities at various institutions.

AKAM Rural Scientific Outreach Event at Mandvi, Gujarat

As part of the AKAM celebrations, IPR has been conducting a series of scientific outreach activities in rural schools of different districts of Gujarat. The fourth such event was conducted during 11-13th July, 2022 at the Seth Khemji Ramdas Kanya Vidyalaya, Mandvi. This is a Gujarati medium girls' school with over 600 students studying in classes 1-12.

The 3-day event consisted of popular talks on plasma and its applications and exhibition of over 15 working models. Over 400 students and teachers from this school as well as nearby schools and general public visited the exhibition. Principals of schools in Mandvi and Bhuj also visited the exhibition and explored the possibilities of having similar events at various schools in the region in the near future. Students of class 10 & 11 from the host school were trained to explain the exhibits to the visitors. As part of the event, the Gujarati version of the children's comic book on plasma "The Wonderful World of Plasma" was also distributed to all the visiting students and teachers. Students from the school were trained to explain the exhibits to visitors.

A set of 10 posters on plasma and a popular book on plasma "Living with Plasma" were also distributed to the visiting schools for display in their school's library. IPR Outreach proposes to conduct such events in rural schools of Bhavnagar and Porbandar Districts of Gujarat in the coming months.

IPR-CPP AKAM Scientific Outreach Event at USTM, Meghalaya

Under the auspices of "Azadi Ka Amrut Mahotsav", The National Exhibition & Seminar on Plasma Physics (NESPP-2022) was organized by CPP-IPR and IPR in association with the University of Science & Technology, Meghalaya (USTM) during 1-5th August, 2022 at the USTM campus at Baridua, Meghalaya. The Outreach team of IPR transported over 20 working and non-working models, posters, comic book on plasma etc. to Meghalaya to set

up this exhibition on plasma, which is unique in the sense that it is for the first time that such an exhibition was being held in the North Eastern part of the country.

The event was inaugurated by the Honorable Education Minister of Meghalaya, Shri. Lahkmen Rymbui, who also inaugurated the CPP-IPR exhibition on plasma and its applications. The Minister spent a considerable amount of time at the exhibition with the various exhibits on plasma and its applications. He was also eager to know more details about the Plasma Pyrolysis system for waste management.

During the event, a popular talk on Plasma was also delivered by Dr. Ravi Kumar (Head Outreach Division, IPR) to the students of USTM on 2nd August, 2022. Over the 5 days, more than 1000 students from USTM as well as over 800 students and teachers from various schools in Guwahati as well as rural areas in the state of Assam visited the exhibition. PhD Scholars from CPP-IPR as well as MSc Physics students from USTM who were trained by experts from IPR and CPPIPR explained the exhibits to the visitors.

The Honorable Health & Forest Minister of Meghalaya, Shri. James K. P. Sangma presided over the concluding session of the event. He also visited the exhibition and interacted with the students.

Tiranga Yatra

As a part of Azad ka Amrit Mahotsav, series of events and activities were organized during 5-15th August 2022. A Freedom Walk was organized with a theme "Tiranga in Hand and India in Heart" on 10th August 2022 from 10:00 am onwards the IPR campus. The walk was flagged off by Dr. Shashank Chaturvedi (Director, IPR) by handing over the flag to Dr. P K Atrey (Dean R&D, IPR) and Shri Niranjan Vaishnav (Chief administrative Officer, IPR). More than 250 members participated in this event cheering “Vande Mataram” and “Jai Hind” during the walk from the new office building to IPR Guest house.

AKAM - DAE Iconic Week Events @ IPR

Azadi Ka Amrit Mahotsav (AKAM) is a country-wide campaign, dedicated to the people of India for their contribution to India’s evolutionary journey. The Ministry of Culture has allotted an ICONIC week (August 22-28th, 2022) to DAE to conduct special events during this week to showcase the activities and achievements of DAE.
IPR celebrated the ICONIC Week by conducting a week long celebrations from 22-28th August, 2022. In addition to organizing various events at IPR campus, a week-long program entitled “Plasma Gyan”, an exhibition on plasma, its applications and nuclear fusion was organized by IPR Outreach division at the Dept. of Physics, BIT (Mesra), at their Jaipur campus.

The following events and activities were also organized at the IPR main campus during the week.
22/08/2022: Commencement of Iconic week by tree plantation campaign at IPR Campus;

23/08/2022: Visit of 70 students from Deaf and Dumb School, Ahmedabad to IPR;
24/08/2022: Visit of 64 students from Deaf and Dumb School, Ahmedabad to IPR;
25/08/2022: Visit of 55 students from SSIT Engineering College, Gandhinagar to IPR;
25/08/2022: AKAM Lecture on “Towards centenary celebrations”, by Dr. Indira Nityanandam, Director, Bharatiya Bhasha Sanskriti Sansthan, Gujarat Vidyapith;

26/08/2022: AKAM Webinar on “AtmaNirbhar Bharat: Indian GNSS Paradigm and international trends”, by Dr. Surendra Pal, Retired Vice-Chancellor of Defense Institute of Advanced Technology (DIAT), Pune, DRDO. Various competitions like Essay and Slogan writing and Poster were also organized on the subject of Azadi Ka Amrit Mahotsav and Atmanirbhar Bharat for IPR staff and their family members.

Two groups of around 134 students from the School for Deaf Mutes Society, Ahmedabad visited IPR along with their teachers during two days of the Iconic week. These students were shown the various plasma exhibits in the Outreach Hall as well as SST and ADITYA tokamaks. Prior to that, these students were also given a brief introduction to plasma which was translated into sign language by their accompanying teachers. The students also gave a feedback of what they saw during the visit. Director IPR also addressed the group speech and hearing disabled students.

A group of 55 students of engineering from the SSIT College of Engineering, Gandhinagar visited IPR during the Iconic week. They were given an introductory talk in plasma and its applications and then were shown the various exhibits in outreach hall. They were also taken to visit ADITYA and SST-1 tokamaks. Popular talks by Dr. Surendra Pal (Former ViceChancellor of Défense Institute of Advanced Technology, Pune) as well as Dr. Indira Nityanandam (Director, Bharatiya Bhasha Sanskriti Sansthan, Gujarat Vidyapith) were also arranged during the Iconic week.

The AKAM DAE Iconic week was celebrated with great enthusiasm and the relevant details of the events conducted by IPR were uploaded to the AKAM website by DAE.

AKAM Iconic Week Programme at BIT (Mesra) Jaipur Campus

Under the auspices of "Azadi Ka Amrut Mahotsav", IPR organized a scientific outreach programme entitled "Plasma Gyaan" at the Birla Institute of Technology (Mesra), Jaipur campus during 22-26 August, 2022. This programme was part of the DAE AKAM Iconic Week which was celebrated from 22-28 August, 2022 by the Department of Atomic Energy.

The programme was inaugurated by Mrs. Mugda Sinha, IAS, Secretary, Department of Science & Technology, Government of Rajasthan. During her address, she stressed the need to take science outreach to the rural areas of the state and extensively use interactive resource materials to engage the students more effectively.

As part of this programme an exhibition on plasma and its applications and nuclear fusion was set up at BIT Jaipur and students and teachers from several schools in Jaipur as well as students from BIT campus also visited the exhibition. An introduction-cum-training programme on plasma and its applications for science teachers was also orgainsed on 26th August, wherein 10 teachers were trained.
Over 1000 students and teachers from 16 schools and colleges in Jaipur participated in this event. As part of the programme, around 30 students of engineering from BIT as well as +2 science students from a local school were trained to explain the plasma exhibits to the visitors.

The valedictory function was presided over by Sri Ashutosh Vajpei (IAS), Joint Secretary, (Economic Affairs Department), Govt. of Rajasthan.

Academic Visits to IPR

On 1st September 2022, 74 students of 10-12th standard and 2 faculty members of Delhi Public School, Gandhinagar, visited IPR and on 12th October 2022, 37 students of 10-12th standard and 7 faculty members of Shri Maneklal M Patel Institute of Sciences & Research (SMPISR), Kadi Sarvavidyalaya, Gandhinagar, visited IPR.

IPR @ Gujarat Science Conclave of State S&T Ministers

The Gujarat Science Conclave of State S&T Ministers was organized at the Science City Ahmedabad during 10-13th September, 2022. This meeting of state S&T ministers and other dignitaries. As part of this event, an exhibition of technologies developed by various departments was also organized at the Gujarat Science City, Ahmedabad.

In the DAE pavilion of the exhibition, working models of Plasma pyrolysis, Plasma Nitriding and Deep CXR AI software were exhibited. The exhibition was visited by various dignitaries attending the conclave.

IPR Scientific Outreach Programme - Kochi

Under the auspices of "Azadi Ka Amrut Mahotsav", IPR organized a scientific outreach programme entitled "Aurorae-2022" at the Bhavan's Adarsha Vidyalaya, Kakkanad, Kochi (Kerala) during 19-24th September, 2022.

The programme was inaugurated by Prof V. P. N. Nampoori, Emiritus Professor, International School of Photonics, Cochin University of Science & Technology. Sri. Venugopal. C. Govind, Chairman, Bharatiya Vidya Bhavan, (Kochi Kendra) was the Guest of Honor for the event.

As part of this programme, an exhibition on plasma and its applications and nuclear fusion was set up at Bhavan's Adarsha Vidyalaya and over 60 students of 11th std (science stream) were trained to explain the exhibits to the visitors. Students and teachers from several schools in Kochi as well as students from 7 other schools of Bhavan's Vidya Mandir attended the exhibition. In the introduction-cum-training programme on plasma and its applications conducted for science teachers, over 70 teachers in the CBSE stream participated.

An inter-school quiz competition was also organized by IPR outreach as part of the event in which teams from 7 schools participated. Over 2000 students and teachers from 17 schools and colleges in Kochi visited the event.

While the event was coordinated by Shri. Suresh K. (Principal) and Ms. Jyothi Pradeep (Vice Principal), organization of the event was led by Ms. Sandhya K V (Head, Physics Dept) and other staff members of the Physics Department of Bhavan's Adarsha Vidayalaya.

Visit by students of Bodoland Super 50 Mission to CPP-IPR

A group of 34 students and 6 teachers of Bodoland Super 50 Mission (Engineering) visited CPP-IPR on 12th October 2022. Council of the Bodoland Territorial Region of Assam launched the Bodoland Super 50 Mission (Engineering) for preparing students from poor economic background to pursue studies in Basic Sciences and Engineering in premier institutes of India. The group was accompanied by Mr. Victor Narzary, OSD to the Chief Executive Member of the Bodoland Territorial Region (BTR).

Dr. Rakesh Moulick, SO-D, CPP-IPR, delivered a talk to explain the basics of plasma as well as presented various interesting facts and applications of plasma. Later, the students and teachers visited various laboratories and interacted with research scholars and scientist of CPP-IPR. The CPP-IPR outreach cell members along with the Centre Director also had a discussion with Mr. Victor Narzary and his colleagues on how CPP-IPR can contribute in uplifting the science education scenario of BTR by organizing various outreach programmes in BTR. Mr. Victor Narzary pointed out that BTR is lagging behind other regions of Assam in science education and the Bodoland Territorial Council is committed in improving it and CPP-IPR promised every possible contribution it can make to this cause.

25th International Workshop on Electron Cyclotron Resonance Ion sources (ECRIS-2022), Institute for Plasma Research, 12-14 October 2022

The workshop on Electron Cyclotron Resonance Ion sources (ECRIS-2022) was organized by Institute for Plasma Research in association with the Board of Research in Nuclear Sciences (BRNS) during 12-14th October, 2022 at the Entrepreneurship Development Institute of India (EDII), Bhat, Gandhinagar. This three-day workshop was aimed at showcasing some of the activities of various research institutes across the world with a focus on ECR plasmas and their applications. The workshop was conducted in a hybrid mode so as to facilitate both online and offline participation.

The workshop was inaugurated on 12th October at EDII, Gandhinagar. The inaugural session was held in the august presence of the chief guest, Dr. Sumit Som, Director VECC, Kolkata. Dr. Shashank Chaturvedi, Director IPR, Shri Ujjwal Baruah, Project Director ITER-India, Dr. P K Atrey, Dean R&D IPR, Dr. Thomas Thullier LPA, France and Dr. Rajesh Kumar, Convenor ECRIS-2022 along with the Chief Guest Dr. Sumit Som inaugurated the workshop by lighting the lamp and releasing the conference proceedings. The Keynote addresses were delivered by Shri Purushottam Shrivastava, RRCAT, Indore, Dr. Thomas Thullier LPA, France and (Online) Dr. Vaishali Naik, VECC, Kolkata. Around 112 researchers from India and other countries the ECR scientific fraternity participated in the workshop with enthusiasm. A total of 72 scientific papers were presented in this workshop out of which 33 were oral presentations and 39 were poster presentations**.**

Vigilance Awareness Week 2022

Vigilance Awareness Week-2022 (VAW) was observed at IPR from 31st October to 6th November, 2021. The theme of this year's VAW was Corruption Free India for a developed Nation'. As part of this, an “Integrity Pledge” was undertaken by the employees on 31st October 2022, with Dr. Shashank Chaturvedi, Director and Dr. N. Ramasubramanian (CVO, IPR) leading the pledge.

A talk on “Vigilance and Conduct rules” by Sri Dr. Ranjit Prasad Acharya, Retd. Dy. Legal Advisor and Director (Admin), DAE was organized for IPR staff on 17th October 2022. Mr Harshad Chamunde, Administrative officer-II, IPR also delivered a talk on “Vigilance –An effective tool against corruption” on 3rd November, 2022. “Nukkad Natak” was enacted by IPR staff within IPR campus (on 9th November, 2022).

The concluding session of the Vigilance Week was held at IPR on 25th Nov, 2022. This session was presided over by Dr. S. Mukherjee (Dean, Admin), Shri Niranjan Vaishnav (CAO) and Dr.

N. Ramasubramanian (Chief Vigilance Officer). Prizes were also distributed to the winners of the various competitions organized as part of the Vigilance Week 2022.

IPR Rural Scientific Outreach Programme - Sirohi

Under the auspices of "Azadi Ka Amrut Mahotsav", IPR participated in the exhibition "Vision Rajasthan-2022" which was organized at the Mahatma Gandhi School, Sirohi, Rajasthan during 1-3rd November, 2022. Several Departments of the Government of India participated in this 3-day exhibition. The programme was organized by Friendz Exhibitions & Promotion Pvt. Ltd. (New Delhi) as part of the "Aspirational District Programme Initiative of the Hon'ble Prime Minister of India", at Sirohi as Sirohi is one of the Aspirational Districts listed under the Niti Aayog. As part of this exhibition, IPR participated under the banner of DAE and exhibited several working models of plasma, its applications as well as tokamaks. Over 5000 students and general public from Sirohi and neighbouring districts visited the IPR stall in this exhibition. The IPR stall also received the award for the "Stall with the Best Exhibits" from Shri Devji Patel, (MP, Jalore-Sirohi), who earlier visited the IPR stall and interacted with the IPR staff.

Academic Visits to IPR

36 students of 11th standard and 3 teachers from Shree Narayana Higher Secondary School, Kathwada visited IPR on 12 November, 2022.

Seminar on Plasma for Space and Aerospace Applications (PSAA-2022), Institute for Plasma Research, Gandhinagar, 24-25th November 2022

A two-day seminar on "Plasma for Space and Aerospace Applications (PSAA-22)" was organized by IPR at FCIPT, IPR, during 24-25th November 2022. The objective of the seminar was to disseminate the information regarding the available expertise and infrastructure at IPR in the area of plasma-space technologies. Further, it was also aimed at providing a platform for the other experts in this field to present their capabilities, and for start-ups to discuss about the issues faced by them so that their solutions can be explored using plasma based technologies.

The inaugural session of the seminar was held in the presence of Chief Guest Dr. Anil Kakodkar (Chancellor, Homi Bhabha National Institute; Member, Atomic Energy Commission; Former Secretary, Department of Atomic Energy), Guest of Honour Shri A. S. Kiran Kumar (Former Secretary, Dept of Space, Vikram Sarabhai Professor ISRO; Member, Space Commission, Govt. of India), and Distinguished Guest Prof. P. I. John (founder of FCIPT; former Senior Professor, IPR), along with Dr. Shashank Chaturvedi (Director, IPR), Dr. P. K. Atrey (Chairman, LOC-PSAA-2022) and Dr. –Ing. Suryakant Gupta (Convener, PSAA-2022) inaugurated the seminar by lighting the traditional lamp and releasing the seminar Abstract Book. A welcome address was given by Dr. Shashank Chaturvedi, Director, IPR followed by addresses from the Chief Guest and the Guest of Honour. The subsequent technical sessions followed after the inaugural sessions with the keynote address by Dr. P. I. John.

The Seminar was attended by approximately 200 delegates (both in offline and online modes) from reputed institutes like various centres of ISRO viz. SAC, LPSC, IN-SPACe, URSC, NSIL etc. and private start-ups & industries like M/s Dhruva Space, M/s Bellatrix Aerospace etc. Experts

from these institutes and industries have also delivered lectures. Presentations mainly covered broad areas like Plasma Thruster & associated Technologies, SPIX Test facilities, Plasma based surface engineering & coatings for space applications, Plasma diagnostics, Plasma based aerodynamic drag reduction studies, Simulation & CFD analysis, availability of high heat-flux test facility and neutron & ion irradiation facilities, reconfigurable plasma antenna and indigenous development of cryo pumps for space applications etc. Presentations also included unique topics like Business Opportunities in Space sector. Private start-ups like M/s Dhruva Space and M/s Bellatrix Aerospace have also contributed by presenting on interesting topics.

The seminar was concluded with a panel discussion anchored by Dr. Nirav Jamnapara, Head, Projects Technology Transfer Section, IPR. The panel lead by Prof. P. I. John comprised of subject experts from government institutes viz. SAC, LPSC, and from private industries like M/s Cenerge Engineering Solutions and M/s Bellatrix Aerospace. The Panel obtained feedback from participants about the seminar and also discussed about the potential possible collaboration areas.

Constitution Day Celebration @ IPR

The constitution day is celebrated every year on 26th November to commemorate the adoption of the constitution of India as Jan Bhagidari and to honour and acknowledge the contribution of Founding Fathers of the Constitution. On this occasion, an online seminar was arranged Advocate Shri Munjal Bhat on 25th November 2022. The topic of the seminar was “The Constitution of India”. Mr. Bhatt is the Managing Partner of M. R. Bhatt and Company. His prime areas of practice include civil and criminal litigation, arbitration, advisory services and drafting of legal documents. He completed his LLB from GNLU in the year 2015 and went on to complete his LLM from New York University School of Law in 2016.

International Day for the Elimination of Violence against Women

In connection with the subject International Day for the Elimination of Violence against Women", a talk was delivered by eminent lawyer Ms. Hemlata Verma on 9th December 2022. Ms. Verma is also an external expert in IPR's Complaint Committee against Sexual harassments at work place. This talk was attended by several women staff of IPR.

37th National Symposium on Plasma Science & Technology (PLASMA-2022)

The 37th National Symposium on Plasma Science & Technology (PLASMA-2022) was organized by IIT Jodhpur in association with Plasma Science Society of India (PSSI) during 12th-14th December, 2022.
The theme of the PLASMA-2022 was Plasma Technologies for Sustainable Development.

The symposium included keynote addresses, invited & popular talks by eminent scientists along with oral and poster presentations by the research scholars and other participants

Plasma Exhibition @ Plasma-2022

As IPR Outreach initiative towards popularization of plasma, an exhibition on plasma, its applications and fusion was organized at IIT-Jodhpur in the sidelines of the “Plasma-2022” conference organized there during 12-14th December, 2022. The exhibition, which was organized at the Jodhpur club in the IIT campus, was inaugurated by Director IIT-Jodhpur, Prof. Santanu Chaudhury. Students

from schools of Jodhpur as well as students, staff and family members of staff of IIT-Jodhpur attended the exhibition. The exhibition also had popular talks on plasma and its applications. Over 800 visitors visited the exhibition. This event was coordinated by Dr. Prabhat Jaiswal and Dr. Shahab Ahmad of the Dept. of Physics, IIT-J.

CPP-IPR's Outreach Activity at Assam State Science Fair - 2022

CPP-IPR participated in the State Science Fair and State Level Children's Science Congress (NCSC) - 2022 held at the premises of Government Higher Secondary School, Tezpur from 16-19th December, 2022. National Children's Science Congress is a nationwide programme of National Council for Science and Technology Communications, Department of Science and Technology, Govt. of India. In Assam, it is also supported by Science, Technology and Climate Change Department, Government of Assam. Around 300 projects from different districts of Assam were presented and around 1000 delegates, including students, teachers and scientists of schools, colleges and national institutes from various parts of North East India participated in the programme. In the CPP-IPR stall, a working model of glow discharge plasma was exhibited as well as posters on various aspects of plasma physics. Comics and articles on plasma physics were also distributed to visiting students and teachers. The stall was visited by around 400 visitors, including students, teachers, guardians and local public of Tezpur. Dr. Rakesh Moulick also delivered a talk on plasma physics in the activity corner of the fair, attended by around 100 students and teachers from various parts of Assam.

38th DAE Safety & Occupational Health Professionals Meet-2022

The 38th DAE Safety & Occupational Health Professionals Meet-2022 was jointly held by Atomic Energy Regulatory Board (AERB) and Nuclear Power Corporation of India Limited (NPCIL) from 19 to 21nd December 2022 at Kakrapar Site. The themes for this year's meet were "Self-Realization for Safety Culture" for Industrial Safety and "Occupational Health Hazards, its monitoring & control" for Occupational Health. This meet was inaugurated by Shri G. Nageswara Rao, Chairman-AERB. About 150 delegates from various DAE units and DAE aided institutes physically attended and around 40 delegates participated virtually. The meet was physically attended by Shri Devendra Modi (who also received the certificates) and virtually joined by Shri Mehul Chodvadiya and Shri Dipankar Dutta. As part of this event, various competitions were held at IPR. Best entries in each competition had been forwarded to the organizer. IPR has won three prizes in various competitions.

IPR @ 108th Indian Science Congress

IPR participated in the "Pride of India" exhibition organized as part of the 108th Indian Science Congress which was organized at the Rashtrasant Tukadoji Maharaj Nagpur University during 3-7th January, 2023. IPR participated under the DAE pavilion along with other units of DAE. The IPR stall had working and static models related to applications of plasma. Students from the Government Institute of Forensic Science, Nagpur were selected as technical volunteers for this event and they were trained to explain the IPR exhibits to visitors, especially in local language. The exhibition was visited by over a lakh visitors from all walks of life. The DAE Pavilion, under which IPR participated, won the award for the "Most Informative Pavilion".

Fifteen students of the 1st and 2nd year MSc Forensic

Science from the Government Institute of Forensic Science, Nagpur, were selected as technical volunteers for IPR stall. They were trained by the IPR team to explain the exhibits to the visitors. IPR exhibited over 10 working and static models based on applications of plasma and fusion. Dr Samir Khirwadkar, Head, High Temperature Technologies Division and member of IPR team visited several educational institutions in Nagpur such as Hadas High School, Shivaji Science College, as well as Department of Physics, Nagpur University and interacted with students and faculty regarding R&D being undertaken by IPR in the areas of plasma and fusion.

IPR Academic Visits (December 2022 - January 2023)

On 7th December 2022, 24 students of classes 9-12th and 3 teachers from Indo-Science Education Trust, Pune, Maharashtra, visited IPR. On 20th December 2022, 63 students of class 11 and 3 teachers from Hiramani School, Ahmedabad and 56 students of classes 6-12 and 6 teachers, from Noble Vigyan Prasarak Bahuuddeshya Sanstha, Jalgaon, Maharashtra visited IPR. On 17th January 2023, 117 students of classes 9-12 and 5 teachers from Madhya Pradesh Lok Shikshan Sanchanalay, Bhopal, M.P. visited IPR. On 18th January 2023, 52 students of BSc & MSc Physics and 5 teachers from Noble Group Institutions, Junagadh, Gujarat, visited IPR.

National Science Day 2023

The National Science Day 2023 was organized during 4-7th February 2023 as an online event. Competitions were held in both offline (Poster and Essay) as well as online (Quiz, Skit, Eloquence and Science models) modes. Around 227 students and 09 teachers from 55 schools across Gujarat state participated in the various competitions that were conducted online over a week. Students and teachers from 23 schools won a total of 39 prizes.

The concluding session of NSD-2023 was conducted online on 28th February 2023. The session was presided over by Director IPR Dr. Shashank Chaturvedi, and Dean (R&D), Dr. P K Atrey. Director IPR addressed the participants online, which was followed by the declaration of prize winners and feedback from participants.

Plasma Exhibition at MahaEduFest 2023

IPR participated in the MahaEduFest 2023 that was organized by Indo Science Education Trust and the NM Foundation and Research Centre, at the Lokseva-e-School and Junior College, Pashan, Pune during 13-17th February 2023. ISRO and PRL also participated in this exhibition. IPR displayed 25 exhibits and posters consisting of working and static models related to plasma, its applications as well as tokomaks and the ITER project. The exhibition was inaugurated by Shri A. S. Kiran Kumar, Member Space Commission and the former Chairman of the Indian Space Research Organization [ISRO] & Secretary Department of Space and was attended by several distinguished former scientists from ISRO. Shri Kiran Kumar, along with other distinguished scientists also visited the IPR exhibition. Over the week, more than 6000 students and 150 teachers from over 43 schools in Pune attended the exhibition. Around 50 selected students of classes 9-11th from the host school were trained to explain the exhibits to the visiting students and public. School teachers visiting the exhibition were also provided with resource materials on plasma such as posters, science activity kit, comic book and a popular book on plasma.

F. Other Activities

F.1 Outreach

Outreach Division carried out several national as well as rural scientific outreach activities during the year 2022-23. These include organization of scientific outreach events on plasma science & technology within Gujarat state and outside the state, training programs for teachers, facilitation of academic visits to institute by educational institutions across India and adding new exhibits and resource materials to institute's outreach activities.

Table F.1: Events conducted by outreach division is tabulated.

No.	Event	Number of times	Participants
1	Academic visits by educational institutions to IPR	39	1688
2	Plasma outreach exhibitions outside Gujarat	11	~3,30,000
3	Rural Plasma outreach programs	05	~5000
4	National Events (NSD/NTD)	02	~3000
5	Training programs for teachers	04	183
6	Students trained during plasma exhibitions	16	468
7	Total number of models in IPR exhibition	25	-

Institute participated in three national level exhibitions organized by various government bodies and the instute's exhibits won awards at all the three events. Gujarat Science Carnival 2023 awarded the "Best innovative exhibit" award to institute's stall. Institute also participated in the 109th Indian Science Congress under the DAE pavilion.

A solar telescope with high resolution H-α filter for imaging of solar surface activities has been installed at the instute. This will be used to organize solar observation events for school students.

Several downloadable videos based on all the events organized by the instute, downloadable resource materials in the form of books, posters, comics (in 14 languages) as well as posters of all the exhibits have been added on the instute's outreach website. Students can download and use the same for learning and knowledge sharing.

In the 4, one-day training programmes organized for science teachers, around 183 science teachers were introduced to plasma, its applications and nuclear fusion through a series of popular lectures and hands-on exhibits. The participants of the training program were also provided with certificates as well as resource materials to help them introduce plasma to their students.

During the 16 outstation outreach events that were conducted during this period, around 486 students from local schools/colleges were trained by the instute staff to explain the exhibits to visitors in their local language. Enthusiastic participation of young mind not only served the purpose of outreach in

a big way but also was useful in enabling a better interaction with the visitors especially during rush hours. These scientific volunteers were also provided with certificates.

39 academic visits by various academic institutions to IPR were facilitated by the Outreach Division. The Outreach exhibition-cum-lecture hall was also made fully operational during this period with large attractive graphics displays of Tokamaks as well as instute's facilities.

National Science Day 2023 was celebrated as online event this year. Over 600 students and teachers participated in the various competitions organized as part of this event. The National Technology Day 2022 was also celebrated in collaboration with the L D College of Engineering, Ahmedabad. During this off-line event, over 2000 students from various engineering colleges across Gujarat participated in the various events.

Design for the IPR Outreach mobile exhibition bus has been completed and approved by DAE Public Outreach Committee. Implementation of the work will begin as soon as funds are released by DAE.

Outreach Activities @ CPP-IPR

In the month of February 2023, the Outreach Cell of Centre of Plasma Physics-Institute for Plasma Research (CPP-IPR) conducted two "Seminar-cum-Workshop on Plasma Physics". The main objective of these programmes was to sensitize the college students of North Eastern region of India about plasma physics. The first programme was held at Jagiroad College, Jagiroad, Assam on 2nd February, 2023 and was attended by 43 students from Jagiroad College and 11 students from Dimoria College, Khetri, Assam. The second programme was conducted at Anandaram Dhekial Phookan College, Nagaon, Assam on17th February, 2023 and was attended by more than 250 students of the college.

During the technical session of the programmes, Dr. Rakesh Moulick gave a talk on introduction to plasma, which was followed by Dr. Ngangom Aomoa who gave a talk on the basics of experimental plasma, touching upon the physics of production of plasma in laboratories with brief introduction to the various laboratories of CPP-IPR. After the two talks, there was also a demonstration session where the students were shown a glow discharge plasma, and the role and working principle of the various components of the set-up was explained to them.

F.2 Official Language Implementation

• In the 18th meeting of the Town Official Language Implementation Committee, Gandhinagar, held on 06.04.2022, the institute received the second prize under the Annual Official Language Shield for the year 2021 for the best implementation of Official Language.

• ATOLIS incentive scheme: DAE's Scheme ATOLIS has encouraged the staff members to do their work in Hindi and staff members are getting benefits according to their work done in Hindi. For the quarter April-June 2022 a total amount of Rs.39,900, for the quarter July-September 2022 a total amount of Rs.44,400, for the Quarter October-December 2022 a total amount of Rs.40,900 and for the Quarter January-March 2023 a total amount of Rs.42,500 cash prize has been awarded to the staff members for doing their work in Hindi.

• National Hindi Scientific webinar was organized by Institute for Plasma Research on 23rd and 24th June 2022 on the topic "Technical/Scientific activities of the Department of Atomic Energy". This Webinar was organized among the various Units/ Organizations/Aided Institutions of Department of Atomic Energy in which 3 plenary talk, 5 invited

talks, 20 oral presentations and 9 posters were presented. Through this two-day webinar, representatives from BARC, Mumbai, IGCAR Kalpakkam, RRCAT Indore, various units of IREL (India) Limited, Tata Memorial Hospital Mumbai, ECIL Hyderabad, AMD Hyderabad, IPR and Iter-India, Gandhinagar presented their scientific activities in simple Hindi language. An abstract book was also released during the inaugural session of the webinar. There were total 37 presentations in the webinar, out of which 25 from other DAE's units/ institutes and 12 from IPR/FCIPT & ITER-India.

• Institute's In-house Hindi magazine 'Plasma Jyoti' was e-published and 12 issues (April 2022 to March 2023) of Hindi monthly magazine "Plasma Samachar" were e-published.

• Hindi Training: Under the Central Hindi Training Institute, 12 officers/employees of Institute for Plasma Research have qualified the Hindi language training exam (Praveen-4, Pragya-2, Parangat-6) organized by Hindi Teaching Scheme in January-May, 2022 session. For Hindi Computer typing training, total 5 Office Clerk-A has been nominated for the August 2022 session exam. All the 5 employees have qualified the Hindi Computer typing exam. Total 9 employees has been nominated for Hindi training exam for the session January-May 2023 (1-Praveen, 1-Pragya & 7-Parangat).

• To promote Indian Government Bhasha Sangam App a competition was organized for the employees from May 2, 2022 to June 30, 2022.

• Three senior officials of the Institute participated in the All India Official Language Conference held on 14th and 15th September 2022 at Surat, Gujarat

• Hindi Pakhwada Celebration 2022: The Institute celebrated Hindi Pakhwada from 16th September, 2022 to 29th September, 2022. During this period total 9 competitions (Technical or non-technical article writing, noting, letter writing and translation, slogan writing, story writing, Vigyan Doha Lekhan, Hindi computer typing, extempore, Hindi quiz, poem recitation) were conducted successfully for IPR employees. Poems of famous Hindi poets and posters made by staff members were displayed during Hindi Pakhwara. A talk in Hindi was also organized on 28th September 2022 on the topic "Kahaniyon Ka Karishma"

• Hindi Workshop: Hindi Workshop have been conducted during September 2022 & and December, 2022. On 22nd December 2022 under the aegis of Town Official Language Implementation Committee, Gandhinagar, a Hindi workshop was conducted by IPR for employees/officers of the member offices of TOLIC, Gandhinagar.

• As a part of talk series 'Technique Ke Saath, Vigyan Ki Baat', a talk in Hindi on "Electro Magnetic Pulse Welding" by Shri Bharat Doshi was delivered on 29 August 2022. Shri Shivam Kumar Gupta, delivered a talk on the "Operation of Central Solenoid Power Supply for different Tokamaks all over the world"on 10th October 2022. On 24 February 2023 Shri Rajiv Sharma, Scientific Offcier-E delivered a talk on "Information on Cryogenic Technology and its Application".

• During this year programmes like Swachhata-Pakhwara-2023, National Science Day 2023, World Hindi Day, Indian Language Day, Environment Day, Vigilance Awareness Week, Women's Day, 52nd National Safety Week, Azadi Ka Amrit Mahotsav etc. were organized, in which various Hindi competitions/activities/skit were organized.

• Under the aegis of Town Official Language Implementation Committee, Gandhinagar the Institute for Plasma Research, in collaboration with Outreach Division conducted a training program on 13-07-2022 for 41 students of class 10 of Kendriya Vidyalaya, Sector-30, Gandhinagar. On this occasion The Students were introduced to plasma science. A talk on Plasma was delivered by Shri Gattu Ramesh, Scientific Officer-F, Member, Outreach Division. Also interesting information related to Plasma Science was provided to the stu-

dents and teachers in simple Hindi language. The students also got an opportunity to visit IPR Lab.

• On 11.11.2022, three officers of the Institute participated in the Official Language Quiz Competition organized by Union Bank of India, Regional Office under the aegis of Narakas, Gandhinagar. Mr. Anuj Kumar Garg, Scientific Officer-E of the Institute has got second position in this competition.

• Quiz, skit, speech and science model, poster, essay competitions in Hindi, Gujarati and English languages were organized on occasion of National Science Day 2023 held during February 4-7, 2023.

• Articles written by Ms. Pratibha Gupta, Scientific Officer-F have been published in the Hindi vigyan sahitya parishad magazine, “Vaigyanik” - “Ardhachalak upkaran:electronics se artificial intelligence tak” in April-June 2022 issue, “Brahmaniya kirne (cosmic rays)” in July-Sept 2022issue, “Vigyan main Nobel puraskar 2022” in Oct-Dec 2022 issue and “Satyendra Nath Bose: ek utkrisht bhartiya bhautik vaigyanik”, in Jan-March 2023 issue.

• Five officers from the institute presented papers on technical subjects in Hindi in the Hindi Scientific Seminar on “Development of Excellent, Indigenous and Relevant Technologies for Self-reliant India” organized by Raja Ramanna Center for Advanced Technology (RRCAT), Indore on July 26, 2022.

• Two scientific officers of the institute participated in the all India Hindi Scientific Seminar on "Role of Nuclear and Other Advanced Technologies in Climate Change Control" organized on 10th and 11th January 2023 at Indira Gandhi Center for Atomic Research (IGCAR, Kalpakkam) and Mr. Anand Visani, Scientific Officer-E bagged first prize for best poster presentation.

• Bharatiya Bhasha Diwas was organized on 7 December 2022 in the institute. On this occasion, the staff members signed in their mother tongue on the notice board placed in the campus of the institute. A talk by Mr. Rajan Babu, Scientific Officer-F on Dr. Subramaniam Bharati was also delivered in Tamil. Elocution competition was organized in which the participants expressed their views in different languages like Tamil, Telugu, Marathi, Bengali, Gujarati, Awadhi etc.

• Hindi Officer participated in the experience exchange workshop organized by DAE Mumbai at RRCAT Indore on 8, 9 and 10 December 2022.

• Mr. Vikas Gaur received the first prize for Hindi slogan writing in the slogan writing competition organized under the 38th DAE Safety and Occupational Health Professional Seminar during December 19-21, 2022.

• On the occasion of "Vishwa Hindi Diwas" on 10 January 2023, two talk were organized. One talk by Dr. Damodar Khadse on “Hindi on World Forum” and the another in online mode by Dr. Purushottam Srivastava, RRCAT, Indore.

• Hindi Inspection: Hindi Inspection of Admin-1 (April 2022), Stores Section (September 2022), Purchase Section (September 2022) & Admin-3 Section (December 2022) was conducted during this period and the review report has been submitted to the Director.

• On March 3, 2023, the Joint Regional Official Language Conference for the year 2023 of the Central and Western regions was organized in Raipur, Chhattisgarh. Shri Niranjan Vaishnaw, Chief Administrative Officer of the Institute participated in this conference.

• On the occasion of Women's Day in March 2023, three special talks were organized in Hindi.

• Institute of Hotel Management, Gandhinagar organized a Hindi workshop on 29.03.2023 through online mode under the auspicious of TOLIC, Gandhinagar, in which the Hindi officer of Institute for Plasma Research gave training on the topic "Useful tools for using Hindi on computer".

• Translation work: Translation of Annual Report 2021-2022, Translation of Review Report of Annu-

al Report 2021-22, Translation of Activity Report 2022-23, Translation of Outcome Budget, Translation of Section 3(3) documents, Translation of various matters of day- to-day activities done during this period.

The Institute is thus continuously making special efforts for promoting the use of official language among its staff members and in communication with other institutes/offices

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F.3 Right To Information

During the report period 2022-23, a total of 133 RTI applications were received, out of which 126 were of new RTI Application, while the other 7 were of Appeal in nature and 2 CIC Appeal.

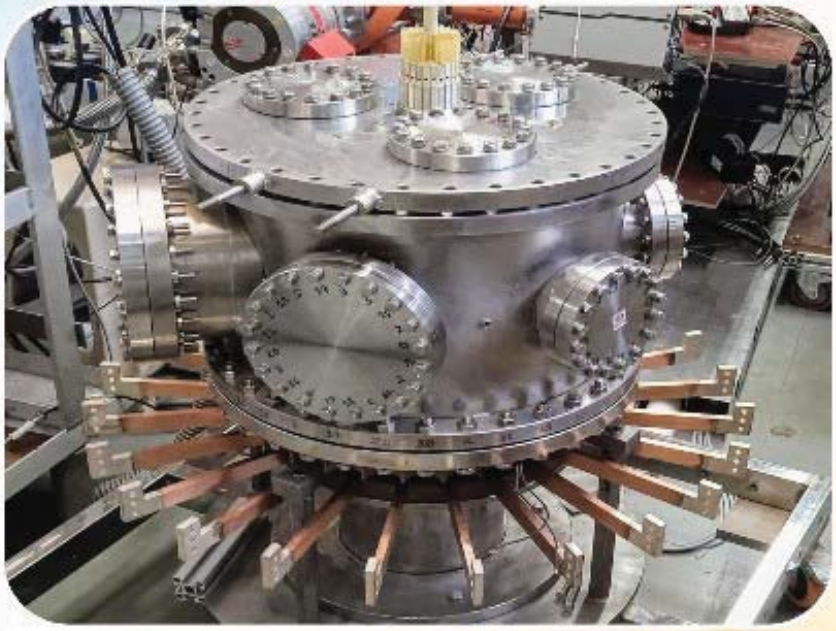
All of the above have been disposed off by the Public Information Officer and Appellate Authority within the prescribed time-limit.

प्रायोगिक हीलियम कूलिंग (ईएचसीएल) प्रणाली का उद्घाटन

Inauguration of
Experimental Helium Cooling Loop

न्युट्रॉन एवं आयन विकिरण सुविधा का उद्घाटन

Inauguration of Neutron and
Ion Irradiation Facility



नवनिर्मित SMARTEX-C वैक्यूम चैम्बर

Upgraded SMARTEX-C vacuum chamber

108 वें भारतीय विज्ञान कांग्रेस में "सर्वाधिक जानकारीपूर्ण मंडप" के पुरस्कार के साथ प्लाज़्मा अनुसंधान संस्थान की टीम

IPR team with the "Most Informative Pavilion" award at the 108th Indian Science Congress

12-14 अक्टूबर 2022 के दौरान आयोजित ई सी आर आई एस - 2022 सम्मेलन की कार्यवाही का विमोचन

Release of the ECRIS-2022 Conference Proceeding held during 12-14 Oct 2022

नराकास, गांधीनगर के तत्वावधान में आईपीआर द्वारा स्कूल के छात्रों के लिए आयोजित प्रशिक्षण सत्र में प्रतिभागियों का सामूहिक फोटो

Group Image of the participants of the training session organized for school students by IPR under the aegis of TOLIC, Gandhinagar.