

Issue 111

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The Fourth State

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



Technology Transfer of Plasma-Based Technologies

Technology transfer agreements were executed with three Indian industries: (a) Knowhow related to plasma pyrolysis technology for waste disposal was transferred to M/s Excel Industries. (b) Technology for production of metal oxide nano powders using a plasma process was transferred to M/s FCG Hi-Tech Private Limited. Metal oxide nano powders have immense applications in the field of pharmaceuticals, paints, chemicals, fertilizer & agri-nutrients, animal health etc. (c) Technology for AGATSYA-400, a liquid nitrogen cooled cryopump, capable of high speed pumping of water vapor and nitrogen for generation of Ultra High Vacuum (UHV) conditions, was transferred to M/s Cenerge Engineering Solutions.

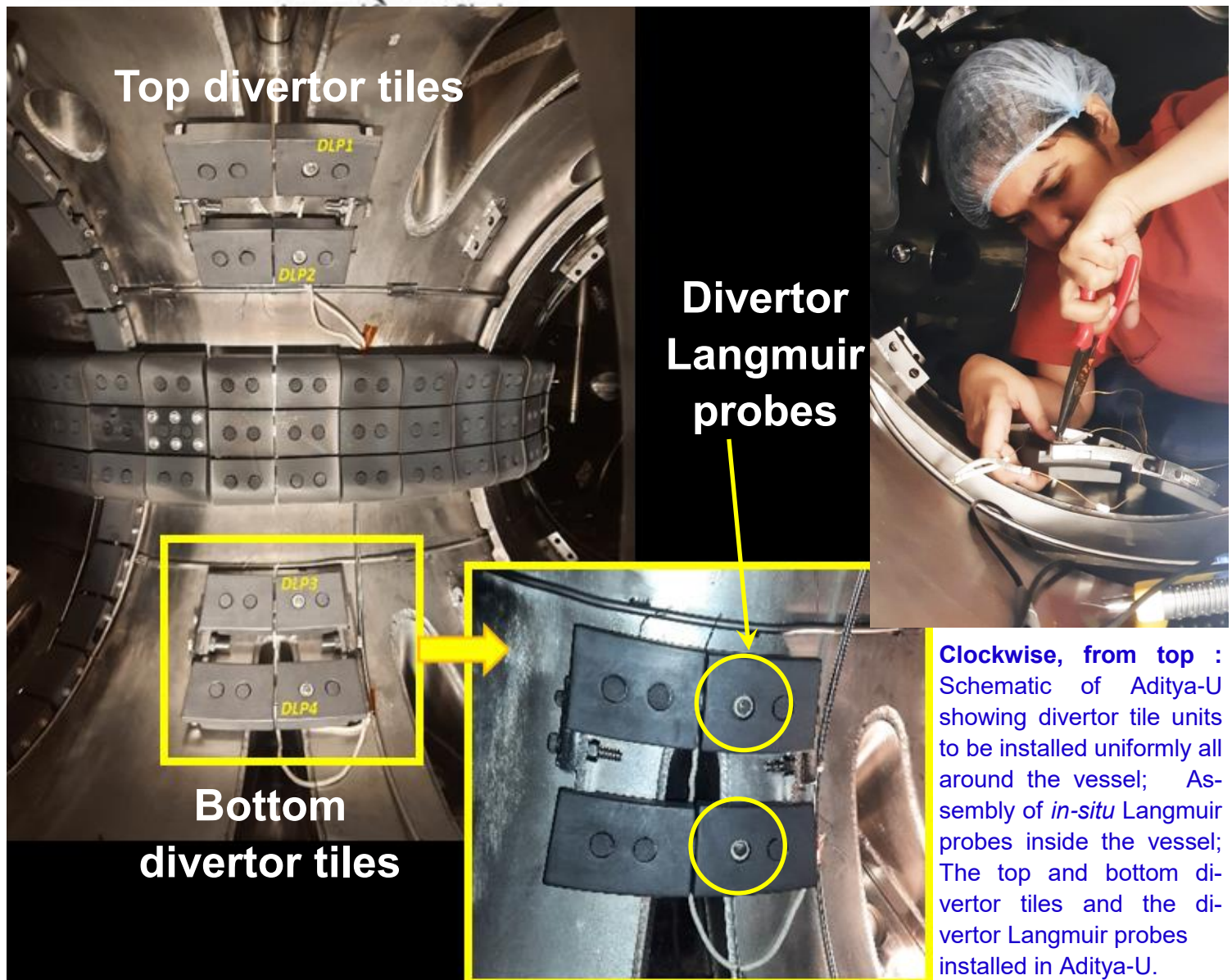
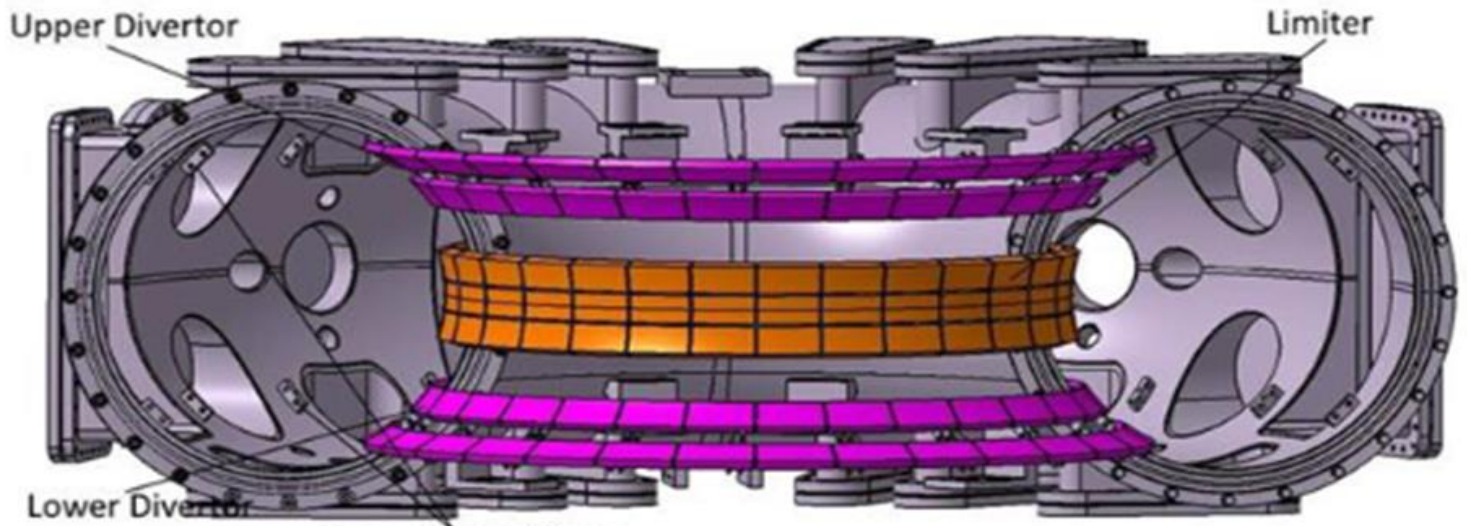


Agreement execution ceremony with M/s FCG Hi-Tech Private Limited



Agreement execution ceremony with M/s Cenerge Engineering Solutions

After completion of design/simulation of Aditya-U Divertor plasma facing components (PFCs), the tiles and support structures have been fabricated. These graphite tiles were vacuum conditioned using various procedure i.e. UHV compatibility, ultrasonic cleaning, heat treatment in vacuum furnace (with support of VESD group) etc. Recently, the first set of top and bottom graphite divertor tiles have been installed inside the ADITYA-U-vessel. The top and bottom divertor tiles assembly units (highlighted in yellow), both consist of 4 individual tiles. In each unit, two flush Langmuir probes (highlighted in red) are installed to study the plasma properties in divertor region, especially during shaped plasma experiments. In future, similar divertor tile units will be installed uniformly all around the vessel as shown in the conceptual design below. The entire task has been led by Mr. Kaushal Patel. ADITYA-U tokamak is being operated in circular plasma formation with above mentioned divertor plates. This is an important step ahead towards the direction of Aditya-U shaped plasma operation as we will gradually get acquainted to operate in presence of new tiles. The Langmuir probe installed on these graphite tiles will also provide valuable feedback.



Clockwise, from top :
Schematic of Aditya-U showing divertor tile units to be installed uniformly all around the vessel; Assembly of *in-situ* Langmuir probes inside the vessel; The top and bottom divertor tiles and the divertor Langmuir probes installed in Aditya-U.

'तकनीक के साथ, विज्ञान की बात' हिंदी वक्तव्य श्रृंखला-4 के अंतर्गत 29 अगस्त 2022 को श्री भरत दोशी द्वारा 'इलेक्ट्रो मैग्नेटिक पल्स वेल्डिंग' विषय पर हिंदी में वार्ता दी गई। इस कार्यक्रम का आयोजन संस्थान के सेनिमार हॉल में किया गया। इलेक्ट्रो मैग्नेटिक वेल्डिंग प्रक्रिया एक ठोस अवस्था की प्रक्रिया है, जिसमें दो अलग-अलग या समान धातुओं को जोड़ा जाता है। श्री भरत दोशी ने इलेक्ट्रो मैग्नेटिक पल्स द्वारा विभिन्न धातु को जोड़ने की प्रक्रिया पर विस्तृत रूप से चर्चा की और श्रोताओं के संदेहों को दूर किया। वार्ता के पश्चात् वक्ता द्वारा इस विषय पर आधारित कुछ प्रश्न श्रोतागणों को पूछे गये और सही उत्तर देने वाले विजेताओं को पुरस्कृत किया गया। कार्यक्रम के अंत में श्री राजसिंह ने इस तकनीकी विषय पर सरल भाषा में प्रस्तुति देने के लिए श्री भरत दोशी को धन्यवाद दिया और सेमिनार हॉल में उपस्थित श्रोतागणों को आगामी श्रृंखला में अपने प्रभाग की तकनीकी गतिविधियों पर हिंदी में वार्ता प्रस्तुत करने हेतु प्रोत्साहित किया।



प्रश्नोत्तरी सत्र



(L) वार्ता देते हुए श्री भरत दोशी (R) धन्यवाद ज्ञापन देते हुए श्रीराजसिंह



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 22-28, 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 22-28 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.



Tree planting campaign at IPR campus during the AKAM Iconic week



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.



Director IPR interacting with the deaf & mute students



Deaf & mute student giving his feedback of the visit to IPR



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 out-reach hall. They were also taken to visit Aditya and SST-1 tokamaks. Popular talks by **Dr. Surendra Pal** (Former Vice-Chancellor 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.

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 organised 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. For more details click [HERE](#).



Inauguration of the event



Mrs. Mugda Sinha visiting the exhibition



The plasma exhibition



Images from the event at BIT (Mesra), Jaipur campus

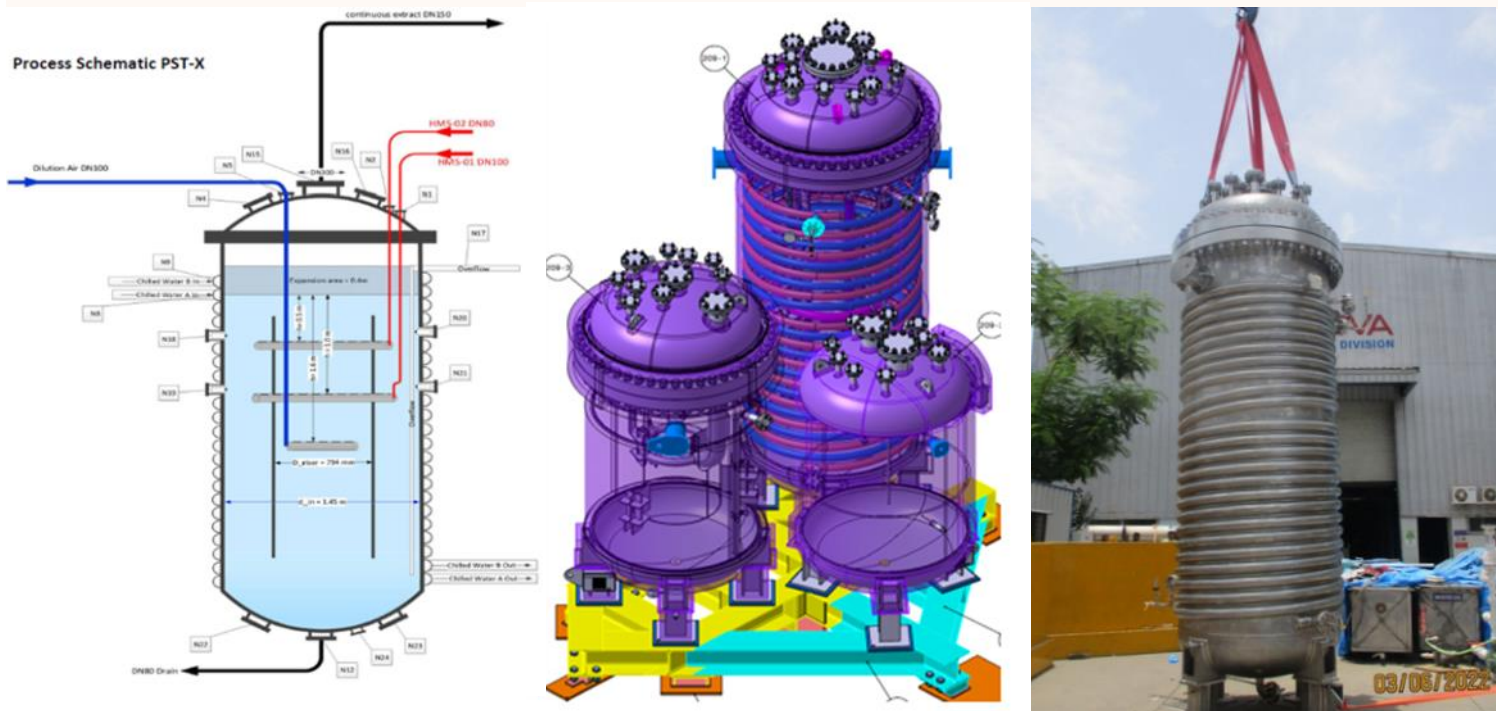
ITER-India has successfully completed the Task Agreement (TA) "Supply of the Hydrogen Mitigation System (HMS) Process Vessels and Support Frame". The scope of this TA includes 'Design analysis, manufacturing, testing, conformity assessment, packing, and delivery of the Hydrogen Mitigation System (HMS) Process Vessels at the ITER Site'.

These vessels are part of the ITER Vacuum Vessel Pressure Suppression System (VVPSS) which protects the ITER Vacuum Vessel from over-pressure faults. The HMS vessels consist of Pool Scrubber Tank (PST), the Quench Tank (QEN) and the Overflow Tank (OFT) and common support frame. The key safety function is to support confinement of radioactivity in Tokamak complex and the capacities of PST, QEN and OFT are 7 m^3 , 5 m^3 and 3 m^3 respectively. The PST vessel which is largest among all is with outer diameter ~ 1.5 meter and overall length ~ 5 meter.

The main functional requirements of the PST include condensation and scrubbing of process gas formed of steam/air/hydrogen/dust mixtures, mixing of the residual process gas with air, and provision of sufficient cooling to prevent overheating. The main functional requirement of the QEN is the cooling, condensation and scrubbing of process gas formed of steam/ air/ hydrogen/ dust mixtures. The main functional requirements of the OFT include the receipt of mixed liquid and gas stream, separation of the two phases and feeding the process liquid to a pumping system.

The vessels are classified as Safety Important Class 1 (SIC-1), Quality Class 1(QC-1) and Tritium Class TC2A and are defined as Nuclear Pressure Equipment (ESPN), under Category IV and level N2 Nuclear Pressure Equipment hence conformity assessment by ANB (Agreed Notified Body) is required. The design pressure is 20 bar(g) and design temperature is 130°C . The vessels are externally insulated (with removable design) with PST vessel having external cooling jacketed design and internal riser assemblies.

ITER-India executed this task through M/s INOX India (Manufacturer) and delivered HMS vessels and support frame to ITER site successfully. Conformity assessment was done by the Agreed Notified Body (M/s Bureau Veritas, France) during contract execution.



(L) Process schematic (M) 3D layout (R) Lifting test of PST being conducted



(L) The PST ready for dispatch (R) HMS vessels being unloaded at the ITER site

प्लाज्मा भौतिकी केंद्र-प्लाज्मा अनुसंधान संस्थान (सीपीपी-आईपीआर) सोनापुर, असम के सम्मेलन कक्ष में दिनांक 20/09/2022 को सुबह 10 बजे से हिंदी पखवाड़ा का शुभारंभ किया गया और जो 29/09/2022 तक चलेगा।

सर्व प्रथम मुख्य अतिथि डॉ. शर्मिला ताये, हिंदी प्राध्यापक, हिंदी शिक्षण योजना, गुवाहाटी को “फूलम गामोछा” और “स्मृति चिन्ह” देकर स्वागत किया गया। इसके बाद इस केंद्र के कार्मिकों द्वारा स्वागत गीत की प्रस्तुती के साथ हिंदी पखवाड़ा का शुभारंभ किया गया। तत्पश्चात् कार्यकारी केंद्र निदेशक ने राजभाषा हिंदी के इतिहास से सभी को अवगत कराया। इसके साथ ही उन्होंने आशा व्यक्त की कि इस केन्द्र के अधिकारी और कर्मचारी अपनी ज़िम्मेदारी को समझते हुए अधिक से अधिक कार्य हिन्दी में करने का प्रयास करेंगे। इसके बाद मुख्य अतिथि डॉ. शर्मिला ताये द्वारा हिंदी कार्यशाला का आरंभ किया गया, जिसमें उन्होंने राजभाषा नियम, अधिनियम और सामान्य हिंदी व्याकरण पर व्याख्यान दिये। साथ ही उन्होंने हिंदी में आमतौर पर कार्य करने में आ रही समस्याओं और उसके निवारण पर भी चर्चा किये। अंत में जलपान और धन्यवाद ज्ञापन के साथ दिनांक 20/09/2022 का कार्यक्रम समाप्त हुआ।



सीपीपी-आईपीआर में आयोजित हिंदी पखवाड़ा कार्यक्रम की कुछ तस्वीरें

The Gujarat Science Conclave of State S&T Ministers was organized at the Science City Ahmedabad during 10-13 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.



Images from the exhibition organized at the Gujarat Science Conclave of State S&T Ministers

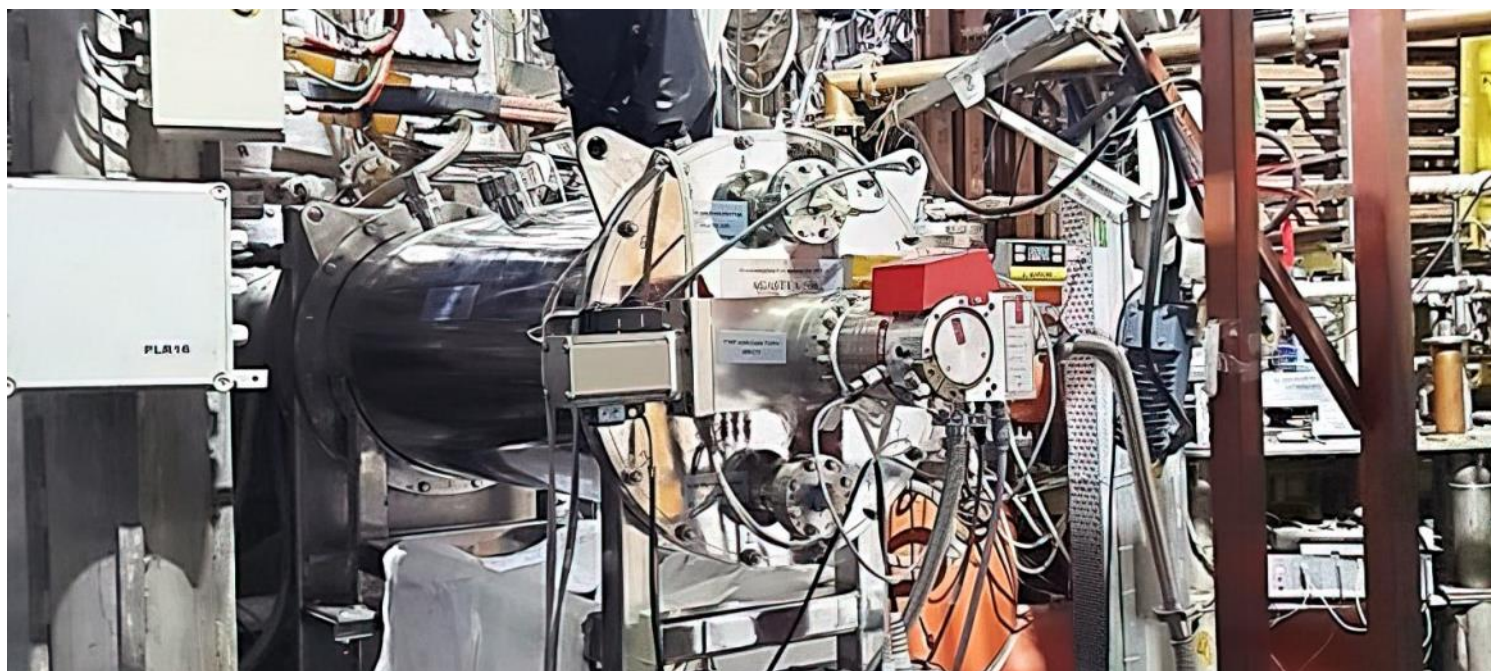


Images from the State S&T Ministers Conclave and visit of Chairman DAE to IPR and Science City, Ahmedabad



Installation of Liquid Nitrogen cooled Cryopump on SST-1 Tokamak

A liquid nitrogen cooled sorption cryopump has been indigenously developed and deployed on the SST-1 Tokamak. It offers a pumping speed of 26,000 liters/s for water vapour and 3,000 l/s for nitrogen. A special feature is that it operates well even during the baking of the vacuum vessel at 110°C, which leads to a high radiative heat load on the pump.



View of installed sorption pump on the radial port of the SST-1 Tokamak

ITER Gets a New Director General



Dr. Pietro Barabaschi
DG, ITER

Following the passing away of then Director-General Dr. Bernard Bigot in May 2022, the ITER Council launched the recruitment effort to select his successor. Subsequently, the ITER Council has appointed Dr. Pietro Barabaschi as the next Director-General of the ITER Organization and he is expected to take office in October 2022.

Trained as an electro-mechanical engineer, Pietro Barabaschi has spent virtually his entire career in the service of fusion research. Shortly after his university studies in Italy, he joined the Joint European Torus, JET, where he worked in the Department of Machine Development. During the Engineering Design Activities (EDA) phase for ITER, he was part of the Joint Work Site in San Diego (USA) and later the Joint Work Site in Garching/Munich (Germany), where by 2006 he was Deputy to the Project Leader and Head of the Design Integration Division. Since 2008, Mr Barabaschi has been the Head of Broader Approach Programme and Delivery for Fusion for Energy (F4E), the European Union organization responsible for Europe's contribution to ITER. (Source : www.iter.org).

On behalf of IPR, we wish him success in his new role.

- ◆ **Mr. Satya Prakash Reddy Kandada**, gave a talk on "*Influence of particle diameter and density on the trap efficiency of acoustic field*" at 5th International Conference of Young Researchers on Advanced Materials, Fukuoka, Japan, 3-6th August 2022
- ◆ **Mr. 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, on 3rd August 2022
- ◆ **Mr. Satya Prakash Reddy Kandada**, gave an invited talk on "*Nanomaterials activity at Institute for Plasma Research, India*" at University of Toyama, Toyama, Japan, on 10th August 2022
- ◆ **Dr. Mukesh Ranjan**, 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
- ◆ **Dr. Sarveshwar Sharma**, gave an invited talk on "*Plasma: Key tool for energy production and industrial applications*" at Delhi Public School (DPS), Gandhinagar, Gujarat, on 20th August 2022
- ◆ **Dr. Sarveshwar Sharma**, 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 (AAPS) and The Korean Physical Society (KPS), South Korea, 22-26 August 2022
- ◆ **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. 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. 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**)
- ◆ **Dr. Mukesh Ranjan**, 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, 27 August 2022
- ◆ **Dr. Infant Solomon Vinoth**, gave a talk on "*Tailoring the composition of copper oxide thin film using reactive magnetron sputtering*" on 29th August 2022
- ◆ **Dr. Mariammal Megalingam**, gave a talk on "*Development of Mach probe for ion flow measurement in the helicon Plasma system*" on 30th August 2022
- ◆ **Ms. Ayushi Vashistha**, gave a talk on "*Study of laser interacting with magnetized plasma*" on 1st September 2022
- ◆ **Ms. Hiral B. Joshi**, gave a talk on "*Experimental Study of Low Power Microwave and Plasma Interactions*" on 1st September 2022
- ◆ **Dr. Abhinav B. Desai**, gave a talk on "*Development of Cryocoolers for Cryopumps*" on 2nd September 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. P. N. Maya**, gave a talk on "*Highlights of the 8th IAEA-DEMO Workshop*" on 13th 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

Upcoming Events

- ◆ 8th International Congress on Energy Fluxes and Radiation Effects (EFRE 2022), Tomsk, Russia, 2-8 October 2022; <https://efre2022.hcei.tsc.ru/>
- ◆ 4th International Conference on Generation IV and Small Reactors (G4SR-4), Toronto, Canada, 3-6 October 2022; <https://www.g4sr.org/>
- ◆ 75th Annual Gaseous Electronics Conference, Sendai, Japan, 3-7 October 2022; <http://www.apsgec.org/gec2022/>
- ◆ Training course on radioactive waste management, SCK CEN Mol, Belgium, 3-11 October 2022; <https://www.sckcen.be/en/events-courses/training-course-radioactive-waste-management-95110ece-234d-ec11-80da-ecf4bbc6e827>
- ◆ Big Science Business Forum 2022 (BSBF 2022), Granada, Spain, 4-7 October 2022; <https://www.bsf2020.org/>
- ◆ Top Fuel 2022: Light Water Reactor Fuel Performance Conference, Raleigh, NC, United States, 9-13 October 2022; <https://www.ans.org/meetings/topfuel2022/>
- ◆ Technical Meeting on Plasma Physics and Technology Aspects of the Tritium Fuel Cycle for Fusion Energy, IAEA Headquarters, Vienna, 10-13 October 2022; <https://conferences.iaea.org/event/287/>
- ◆ 25th International Workshop on Electron Cyclotron Resonance Ion Source (ECRIS-2022), EDII, Gandhinagar, 12-14th October 2022; <https://www.ipr.res.in/ecris-2022/>
- ◆ 13th International Tritium Conference on Tritium Science and Technology, Bucharest, Romania, 16-21 October 2022; <https://www.tritium2022.ro/>
- ◆ Frontiers in Optics + Laser Science (FiO+LS), Rochester, New York, 17-20 October 2022; <https://www.frontiersinoptics.com/home/>
- ◆ 64th Annual Meeting of the APS Division of Plasma Physics, Spokane, Washington, 17-21 October 2022; <https://engage.aps.org/dpp/meetings/annual-meeting>
- ◆ 6th Spectral Line Shapes in Plasmas code comparison workshop, Hyères, France, 17-21 October 2022; <https://plasma-gate.weizmann.ac.il/projects/slsp/slsp6/>
- ◆ Applied Superconductivity Conference 2022, Honolulu, Hawaii, 23-28 October 2022; <https://www.appliedsuperconductivity.org/asc2022/>
- ◆ The Nuclear Materials Conference (NuMat2022), Ghent, Belgium, 24-28 October 2022; <https://www.elsevier.com/events/conferences/the-nuclear-materials-conference>
- ◆ 5th International Ministerial Conference on Nuclear Power in the 21st Century, Washington D.C., USA, 26-28 October 2022; <https://www.iaea.org/events/ministerial-nuclear-power-conference-2022>
- ◆ Fall Meeting of the APS Division of Nuclear Physics (DNP 2022), New Orleans, LA, 27-30 October 2022; <https://tigers.phys.lsu.edu/dnp2022/>

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Know Your Colleague



Mr. Yagneshkumar Trivedi joined IPR in May 2009 as Engineer-SC and currently working as a Scientific Officer-E in the Water Cooling & AC Section. He has implemented, from concept to completion, several Water Cooling Systems and HVAC related works for IPR and FCIPT through tendering process. He has also carried out the design, procurement, testing and commissioning of SST-1 Air Conditioning system for SST-1 area, DX type Air conditioning system for canteen, Neutronics lab and FCIPT labs as well as water cooling systems for basic experimental lab, LVPD lab, HVDC lab etc.

He has participated in several SST-1 operation campaigns. His other areas of expertise include software applications like AutoCAD and Fathom for P&ID preparation, Piping & plant layout design and flow analysis. His work has improvement in the productivity and quality in the work environment.

Lectures @ Events



Dr. Mukesh Ranjan delivered a talk on "Harnessing Plasmas for Societal Applications" at the National Conference on Advances in Physical Sciences for Sustainable Development (NCAPSSD – 2022) organized by the Indian Institute of Teachers Educations (IITE), Gandhinagar on 27 Aug, 2022.



Mr. Deepak Aggarwal of IPR Computer Centre delivered a talk titled "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 on 16th September 2022.



Dr. A V Ravi Kumar delivered the "2022 Physics Alumni Colloquium" entitled "Plasma - Mankind's New Tool" at the Department of Physics, Cochin University of Science & Technology (CUSAT), Kochi, on 15-Sept, 2022. This is an ongoing series of talks by the alumni of CUSAT as part of the 50th year celebrations of the Department of Physics, CUSAT.

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