

Issue 089

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The Fourth State

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



Inauguration of Technology Incubation Center @ IPR

On 30th October, 2020 as part of the “Founders Day” celebrations of BARC, Shri K.N.Vyas, Secretary, Department of Atomic Energy and Chairman, Atomic Energy Commission remotely inaugurated Technology Incubation centers at BARC, IGCAR, RRCAT and IPR. This move is in line with the government’s decision regarding opening up technologies developed by DAE institutions to private partners as part of the “*Aatmanirbhar Bharat*” campaign of the Government of India.

During the remote inauguration of IPR’s Incubation Center, which will be located at FCIPT in Gandhinagar, Director Dr. Shashank Chaturvedi gave a brief description of the already existing technology transfer activities as well as societal applications of plasma which have been, and also are being developed by IPR. This was followed by a brief video on FCIPT made by IPR’s Outreach Division. The Chairman then electronically inaugurated the incubation center from BARC Mumbai.

Following the inauguration, execution of a technology knowhow and license agreement between IPR and M/s Ankur Scientific Energy Technologies Pvt. Ltd., Vadodara, for transfer of Plasma Pyrolysis technology for safe disposal of bio-medical waste was carried out, with the documents being exchanged between Dr. P. K. Atrey (Dean R&D, IPR) and Shri Ankur Jain, Managing Director of M/s Ankur Scientific. 360 degree image is [here](#).



Images from the virtual inauguration of IPR Incubation center

This incubation centre set to be established at FCIPT will focus on nucleating & nurturing technology based startups. This will not only mobilize commercial deployment of IPR's knowhow and technologies, but will also address a number of societal needs with targeted technological solutions. This incubation centre will aim to support Government of India schemes such as 'Swatchh Bharat', 'Atmanirbhar Bharat', 'Swastha Bharat' etc.

The short video on FCIPT and the technologies developed by IPR that was created by Outreach Division for the inauguration event is available at this [link](#).



(Top) The inauguration ceremony conducted remotely from BARC, Mumbai (Bottom) Virtual inauguration of the IPR Incubation center

As part of the activities of the Vigilance Awareness Week being observed at IPR from 27-Oct-2020 to 2nd Nov-2020, an "Integrity Pledge" was undertaken by the employees on 27th Nov, 2020, with Dr. Shashank Chaturvedi, Director and Dr. Anitha V P (CVO, IPR) leading the pledge. In view of COVID-19 pandemic related restrictions, the ceremony was conducted via video streaming, while only few officials were physically present. On 28th Nov, 2020, a webinar on "*Synergy Between Vigilance and Technology*" by Shri Rajnish Kumar, Director (Digital Education), Ministry of Education, New Delhi, was organized. Participants from IPR joined the webinar through video conferencing as well as live video streaming.

Banners /posters based on the subject, "*Satark Bharat, Samriddh Bharat*" ("Vigilant India, Prosperous India") were displayed at various locations at the main campus of IPR. An on-line quiz related to vigilance was also organized for IPR/FCIPT and ITER-India staff on 2nd Nov, 2020.



The webinar on vigilance (Inset) Shri Rajnish Kumar



Images from the various events organized as part of the Vigilance Awareness Week

1 st Prize	Zala Gajendrasinh	FCIPT
2 nd Prize	Rohit Agarwal	ITER-India
3 rd Prize	Suhani J Patel	ITER-India
Consolation Prize	Jasani Rina	ITER-India
Consolation Prize	Pinakine Devluk	IPR
Consolation Prize	Sharad Jash	IPR

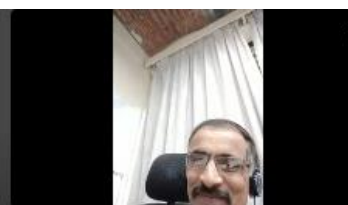
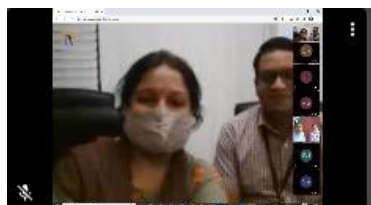
दो दिवसीय हिंदी सेमिनार

संस्थान में दिनांक 5 एवं 6 नवंबर 2020 को दो दिवसीय हिंदी सेमिनार का आयोजन ऑनलाइन माध्यम से किया गया, जिसमें संस्थान की वैज्ञानिक गतिविधियों पर प्रतिभागियों द्वारा पावर पॉइंट प्रस्तुतियाँ दी गईं। हिंदी सेमिनार के अंतर्गत पहली बार आमंत्रित व्याख्यान की श्रृंखला शुरू की गई है। दिनांक 5 नवंबर को डॉ. जॉयदीप घोष द्वारा "आदित्य अपग्रेड टोकामक" विषय पर आमंत्रित व्याख्यान दिया गया। डॉ. जॉयदीप घोष ने भारत के पहले टोकामक 'आदित्य' पर विस्तार से चर्चा की और उसके नवीकरण के पश्चात् आदित्य अपग्रेड टोकामक की प्रायोगिक गतिविधियों एवं लक्ष्यों से श्रोतागणों को परिचित कराया। इसके पश्चात् चार प्रतिभागियों द्वारा विभिन्न विषयों पर पावर पॉइंट प्रस्तुतियाँ दी गईं। दिनांक 6 नवंबर को डॉ. प्रवीण कुमार आत्रेय द्वारा "तनाव प्रबंधन" विषय पर आमंत्रित व्याख्यान दिया गया। डॉ. प्रवीण कुमार आत्रेय ने दैनिक जीवन में तनाव के कारण, तनाव का स्वास्थ्य पर प्रभाव, इसके सकारात्मक एवं नकारात्मक पहलुओं पर विस्तार से चर्चा की और तनावरहित जीवन जीने हेतु समाधान भी प्रस्तुत किये। अगले सत्र में तीन प्रतिभागियों द्वारा पावर पॉइंट प्रस्तुतियाँ दी गईं। सेमिनार की प्रस्तुतियाँ ;

प्रतिभागी	विषय
डॉ. जॉयदीप घोष	आदित्य अपग्रेड टोकामक
डॉ. प्रवीण कुमार आत्रेय	तनाव प्रबंधन
डॉ. रितेश सुगंधी	प्रयोगों और औद्योगिक नियंत्रण प्रणाली के लिए नई सॉफ्टवेयर इंजीनियरिंग तकनीकें - एक समीक्षा
सुश्री हिरल जोशी	प्लाज्मा में माइक्रोवेव का अवशोषण
श्री राजीव शर्मा	एसएसटी-1 के सुपरकंडक्टिंग फीडर सिस्टम के लिए क्रायोजेनिक वैक्यूम बैरियर का इन हाउस विकास
श्री रजनीकांत भटासना	उत्पादन-संबंधी प्रक्रिया में आधुनिक सी.एन.सी मशीनों का महत्व
श्री उपेन्द्र प्रसाद	चुंबक प्रणाली विभाग की गतिविधि पर एक नज़र
सुश्री छाया चावडा	महामारी के दौरान आई पी आर की आउटरीच गतिविधियाँ
श्री अतुल गर्ग	एस एस टी-1 के अतिचालक करंट-फीडर प्रणाली में पीएफ # 3 करंट- लीडस् इंस्टॉलेशन द्वारा अपग्रडेशन



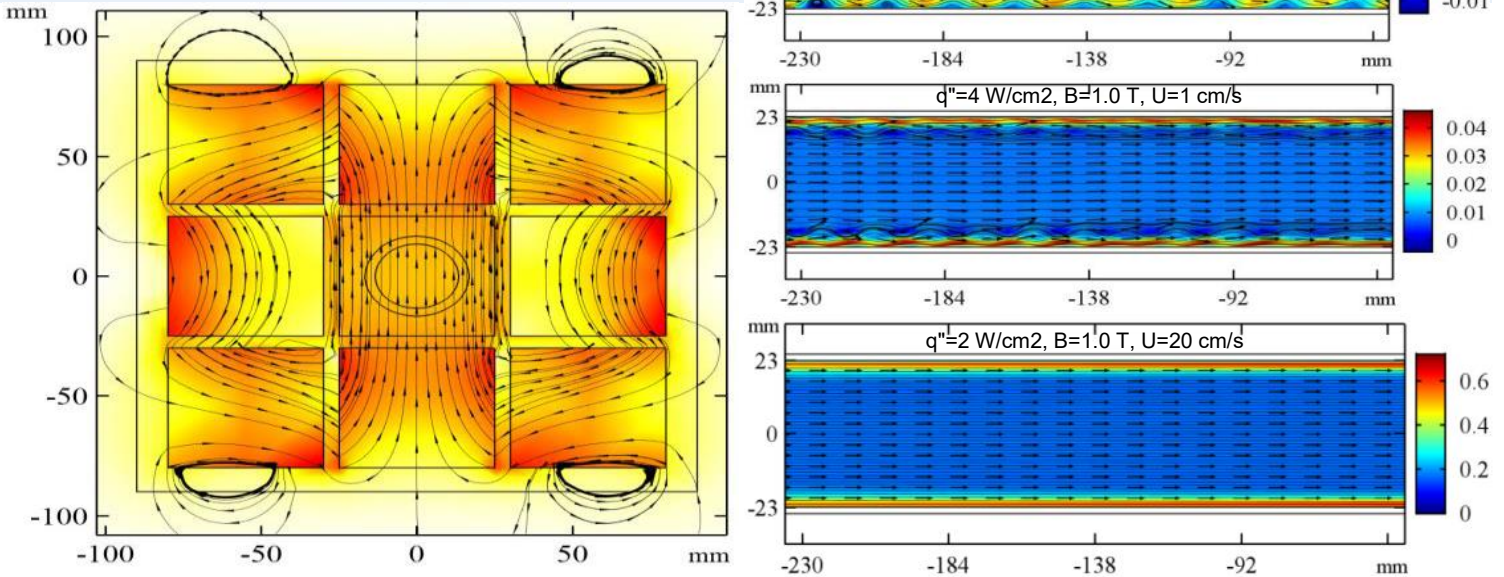
(L-R) डॉ. रितेश सुगंधी, श्री अतुल गर्ग, श्री राजीव शर्मा, और सुश्री छाया चावडा उनके ऑन लाइन भाषण देते हुए



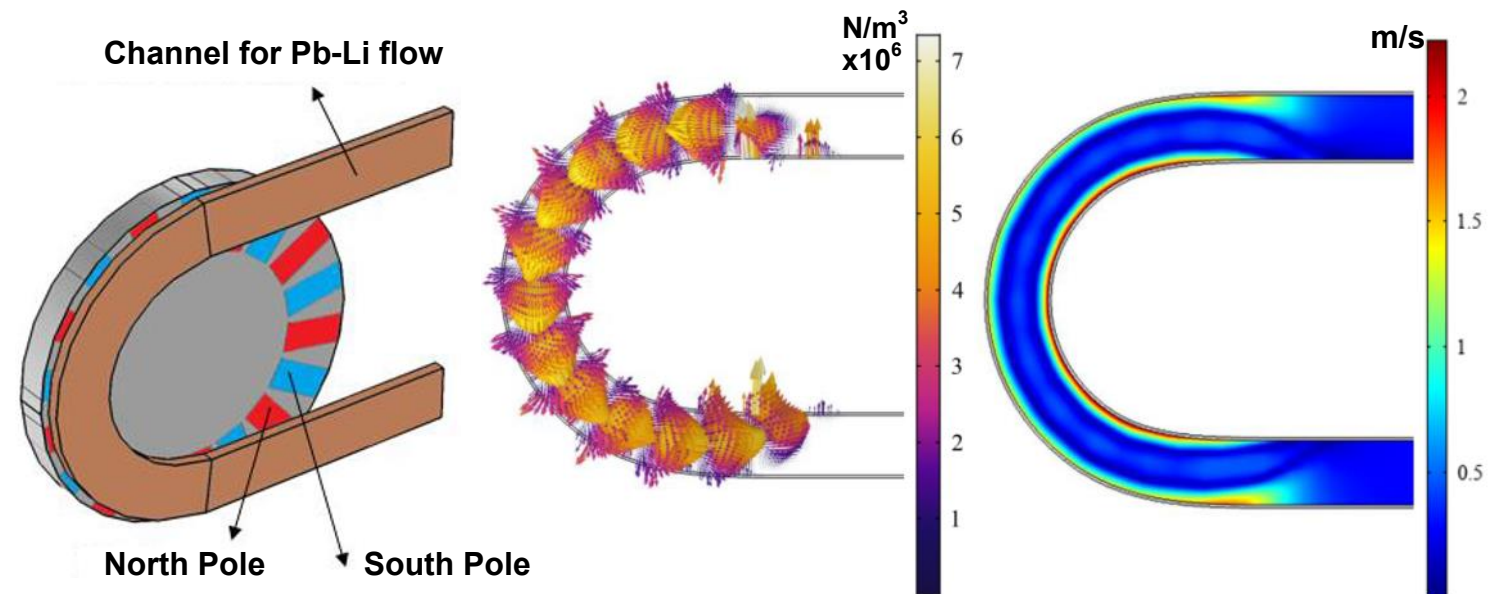
वेबिनार के कुछ प्रतिभागी

For the development of liquid metal technology, a range of multi-physics simulations are being performed using centrally hosted licenses of COMSOL software in ANTYA HPC facility installed in IPR Data Center. Numerical MHD problems take longer computational time due to multi-physics phenomenon, miniature boundary layers with size ranging from microns to millimeter, and length scales varying from few millimeters to a meter. Usually, it takes around 3 days to about a few weeks depending upon flow geometry using a workstation. With the advent of ANTYA, the computational time has significantly come down. The simulations which were taking weeks to complete, are now being completed in a few days in ANTYA. Moreover, the computations with complex flow geometries that were not able to be run on a workstation, are now being run on ANTYA cluster. Recently performed simulations include (a) Study of the flow physics associated with liquid metal flow inside a transverse magnetic field (i.e. magneto-hydrodynamic (MHD) effect), (b) Design of the diagnostics for the measurement of flow parameters and (c) Optimization of the MHD Pump, an important component associated with liquid metal technology. The magnetic field source has been utilized for the development of a flow-meter to measure the volumetric flow of Pb-Li at operational temperatures as high as 400°C. The velocity vector in three distinct flow regimes has been shown for the case with liquid metal exposed to simultaneous buoyancy, electromagnetic, and inertia forces. These flow regimes have distinctive features in terms of heat transfer and flow pattern and their occurrence is dependent on the dominance of any of the applied three forces. In the buoyancy force dominated regime (top plot), two types of eddies are formed, while in the electromagnetic force dominated regime (middle plot), only one type of eddies are formed and in inertia dominated flow regime, M-shaped velocity profile is observed. In a numerical result of the MHD pump, the time-varying magnetic flux generates an induced current in the pump channel, which in turn produces Lorentz forces to drive the liquid.

IPR/TR-566/2020
Flow Meas. and Inst. 66 (2019) 190-199
Phy. Fluids 32, 067107 (2020)



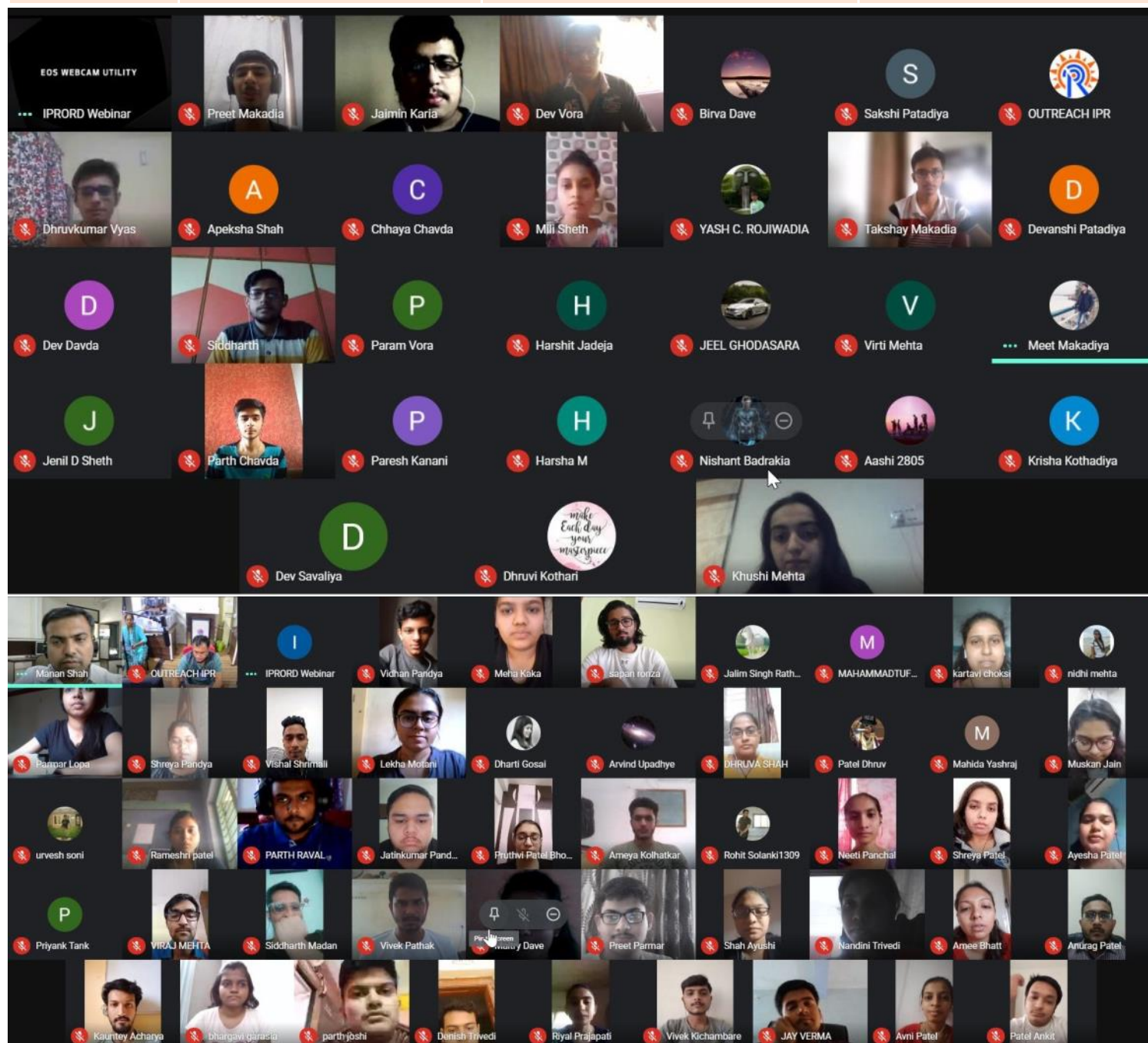
(L) Optimized Magnetic field source design for Pb-Li flow-meter application. (R) Flow physics analysis for Pb-Li flow under the influence of gravity, magnetic field and inertia showing velocity vector in flow regimes with dominance of gravity (top), magnetic field (middle) and inertia (bottom).



Coupled physics analysis of MHD Pump for Pb-Li application showing the Lorentz force and M-shaped velocity pattern

Outreach webinar programmes conducted during the month of November 2020

Date	Institution	Programme	Participants
04-Nov-2020	Shakti Higher Secondary School, Rajkot	1day, 2 hour webinar on Plasma & its Applications for +2 students	37 students of Class 12 and 1 teacher
05-06 Nov, 2020	L D College of Engineering, Ahmedabad	2-day, 4 hour webinar on Plasma & its applications for BTech/MTech/MSc Students	73 students and 1 faculty member
9-10 Nov, 2020	Sir P T Science College, Modasa & Trainers of Gujcost Recognized District Community Science Centre, Aravalli	2-day, 4 hour webinar on Plasma & its applications for BSc/MSc students & Science trainers	54 Students and 2 faculty members
11-Nov-2020	P D Patel Inst of App Sci-CHARUSAT, Anand	1-day 4 hour webinar on Plasma & its Applications for BSc / MSc Students	70 students and 1 faculty member
19-20 Nov, 2020	PGT Physics Teachers from various schools of Bhavans Education Trust across Kerala	2-day, 4 hour webinar on Plasma & its Applications for PGT Physics teachers.	33 +2 science/physics teachers

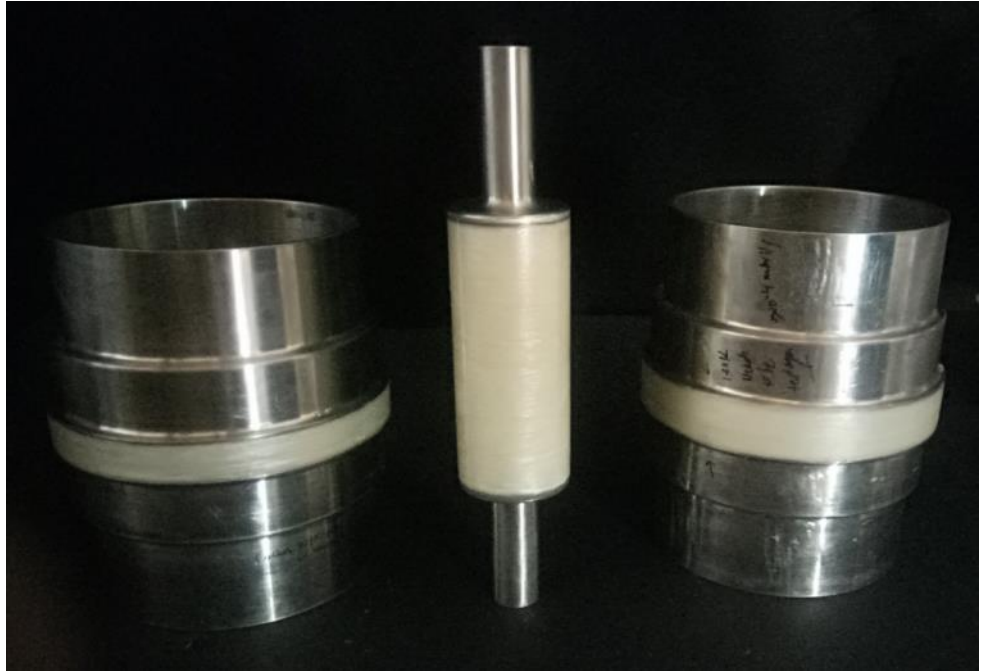
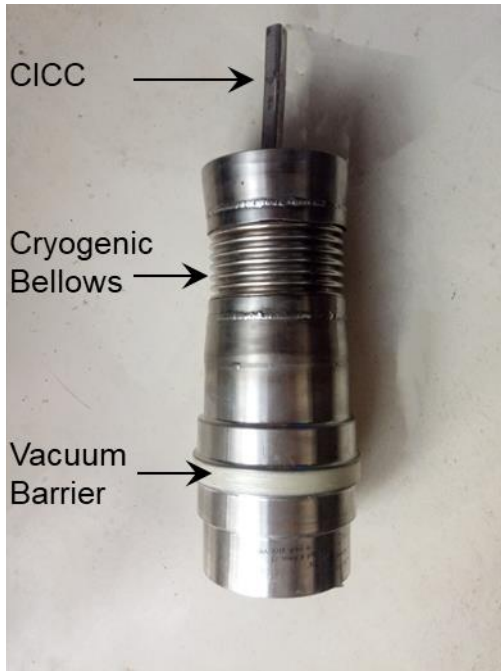


Students of (Top) Shakti Higher Sec. School, Rajkot (Bottom) P D Patel Inst of App Sci-CHARUSAT, Anand attending the webinar.

Development of Cryogenic Vacuum Barrier for Superconducting Feeder System of SST-1 ⁷

A few months back, we had reported details of development of a 50 mm diameter prototype Vacuum Barrier (VB) system. We have hence scaled up the system to a 1:1 scale, with a larger diameter of 127 mm. Fabrication of larger diameter VB systems involves critical issues with dissimilar material joints, where large radial stresses due to temperature difference comes into the picture. Thereby, it was challenging task to demonstrate fabrication and testing of such a larger diameter Vacuum Barrier.

In addition to that, cryo-compatible bellows were incorporated into the system using SS TIG welding. This system was validated in lab conditions of Helium leak tightness test ($< 10^{-8}$ mbar-l/s), Thermal shocks test at 77 K (3 cycles) and high voltage withstand capacity of 10 kV DC. As a next step, this system will undergo Paschen Discharge test in a special cryostat with actual SST-1 CICC geometry to study the performance of this specific component. (Rajiv Sharma, SST-1 Cryogenic division).

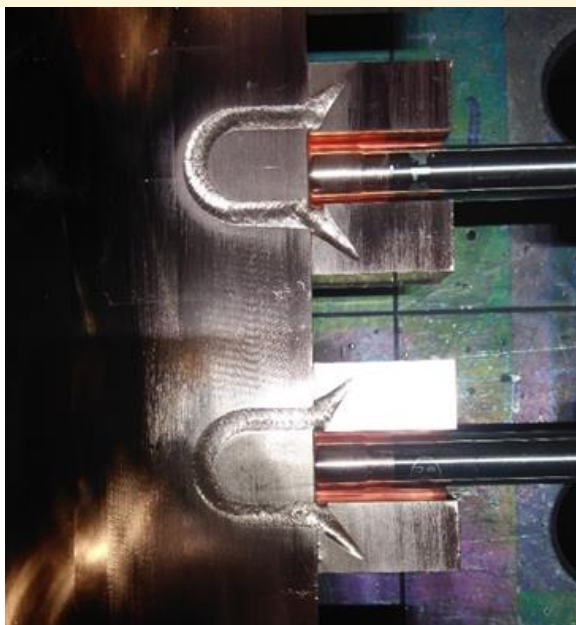


(L) Fully assembled Vacuum Barrier assembly (R) Components of the Vacuum Barrier assembly

Patent On Advanced Manufacturing Technology

Neutral particle beam injectors are an important method of plasma heating in fusion reactors. Indigenous technology development in related areas has been underway for several years at IPR, and a Diagnostic Neutral Beam system is one of the demanding in-kind deliverables to ITER. These require complex manufacturing technologies, especially in the manufacture of actively cooled accelerator grids.

A new welding methodology has been developed that overcomes the limitations of conventional welding techniques like friction welding. This configuration has been applied to the manufacturing of grid segments and tested for all acceptance parameters (destructive, non-destructive and leak rates of 10^{-9} mbar-liter/s as per ITER standards). A US Patent has been granted for this development.



(12) **United States Patent**
Joshi et al.

(10) **Patent No.:** **US 10,480,863 B2**
(45) **Date of Patent:** **Nov. 19, 2019**

(54) **METHOD OF MANUFACTURING ACTIVELY COOLED ACCELERATOR GRID WITH FULL PENETRATION WELD CONFIGURATION**

(58) **Field of Classification Search**
CPC F28D 7/0075; F28D 7/0066; F28D 7/06; F28D 7/16; F28D 7/163; F28D 7/1669;
(Continued)

(71) Applicant: **Institute for Plasma Research, Ahmedabad (IN)**

(56) **References Cited**

U.S. PATENT DOCUMENTS

(72) Inventors: **Jaydeep Joshi, Ahmedabad (IN); Chandramouli Rotti, Ahmedabad (IN); Arunkumar Chakraborty, Ahmedabad (IN)**

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219/124.03
2003/0010410 A1 * 1/2003 Polvi B23K 20/023
148/528
(Continued)

(73) Assignee: **Institute for Plasma Research, Ahmedabad (IN)**

FOREIGN PATENT DOCUMENTS

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 121 days.

GB 2122926 A 1/1984
KR 100727680 B1 6/2007
Primary Examiner — Jermie E Cozart
(74) Attorney, Agent, or Firm — The Webb Law Firm

- ◆ **Mr. Sudhirsinh Vala**, gave a talk on “*Characterization of 2.45 GHz ECR Ion Source Bench for Accelerator-Based 14-MeV Neutron Generator*” at 24th International Workshop on Electron Cyclotron Resonance Ion Sources (ECRIS20), 28-30 September 2020
- ◆ **Dr. Sarveshwar Sharma**, Institute for Plasma Research, Gandhinagar, gave a talk on “*High frequency sheath modulation and higher harmonic generation in a low pressure very high frequency capacitively coupled plasma excited by saw-tooth waveform*” at 73rd Annual Gaseous Electronics Virtual Conference, USA, 5-9 October 2020
- ◆ **Mr. Ansh Patel**, Institute for Plasma Research, Gandhinagar, gave a talk on “*Simulation of runaway electron generation in fusion grade tokamak and suppression by impurity injection*” at 8th PSSI-PLASMA Scholars Colloquium (PSC-2020), PSSI and KIIT University, Bhubaneswar, (online), 8-9 October 2020
- ◆ **4th Asia Pacific Conference on Plasma Physics (AAPPS-DPP2020 e-Conference)**, 26-31 October 2020:
 - **Dr. Shantanu Kumar Karkari**, gave an invited talk on “*Negative Ion Research in Laboratory Devices: Physics and Modeling*”
 - **Dr. L. M. Awasthi**, gave an invited talk on “*Investigations on Electron Temperature Gradient (ETG) Turbulence and Plasma Transport in LVPD*”
 - **A. K. Sanyasi**, gave an invited talk on “*Observations on Whistler Turbulence Induced Reduced Particle Transport in Large Volume Plasma Device*”
 - **Dr. Prince Alex**, gave a poster presentation on “*Spatial Control of Plasma Parameters in a Double Plasma Device by Selective Biasing of a Mesh Separator*”
- ◆ **Mr. Tanmay Macwan**, gave a talk on “*Effect of External Radial Electric Field on the Drift Tearing Modes of ADITYA-U Tokamak*” at 29th International Toki Conference on Plasma and Fusion Research, Ceratopia Toki, Toki-city, Gifu, Japan, 27-30 October 2020
- ◆ **Dr. Promit Moitra**, Institute for Plasma Research, Gandhinagar, gave a talk on “*Dynamics on spatially extended systems*” on 3rd November 2020
- ◆ **Dr. Sabuj Gosh**, Saha Institute of Nuclear Physics, Kolkata, gave a talk on “*Transitions among different kinds of nonlinear oscillations in glow discharge plasma*” on 13th November 2020
- ◆ **Dr. Tejendra Patel**, SVNIT, Surat, gave a talk on “*Condensation heat transfer and frictional pressure drop in a horizontal circular mini-channel*” on 20th November 2020
- ◆ **Dr. Ashok Dave**, University of Ulster, UK, gave a talk on “*GHG capture by physical solvent DMEPEG at a pre-combustion IGCC power plant (390 MWe net power generation)*” on 25th November 2020

Upcoming Events

- ◆ International e-Conference on Structural Materials for Nuclear and Space Applications (SNSA20), Bhabha Atomic Research Centre, Mumbai, 3-6 December 2020 <https://www.snsa20.in/>
- ◆ International Conference on Plasma Science (ICOPS2020), Virtual, 6-10 December 2020 <https://icops2020.org/>
- ◆ 8th National Conference on Recent Trends in Materials Science and Technology (NCMST-2020), 7-9 December 2020 <https://events.iist.ac.in/ncmst2020/index.htm>
- ◆ 38th Annual Conference of the Israel Vacuum Society, to be held jointly with Israeli Conference on Plasma Science and Applications (IVS-IPSTA 2020), online, 13 December 2020 <https://www.ivs.org.il/>
- ◆ High Temperature Plasma Diagnostics Conference (HTPD 2020), Virtual, 13-17 December 2020 <http://www.cvent.com/events/2020-high-temperatures-conference/event-summary-316fe078c3894ef5ab725d6bbdf69334.aspx>
- ◆ 41st Annual Meeting and Symposium Fusion Energy: Achievements and Opportunities 2020, 16-17 December 2020 <https://fusionpower.org/RegistrationForm.html>

Know Your Colleagues

Mr. Sanjay Parmar joined IPR in March 2003 as a Laboratory Assistant in the Neutral Beam Injector (NBI) group. He has contributed in the commissioning and operation of the positive ion source and the liquid helium cryo-condensation pumps. He played an important role in the assembly of beamline components and the beam transmission vessel. He also devised innovative methods for commissioning and calibration of the ion removal magnet of the NBI system. He is currently having a leading role in the upkeep and maintenance of the gauges and field instrumentation of NBI vacuum and cryogenic systems.



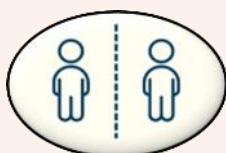
Title	Page No	Title	Page No
Inauguration of IPR Incubation Center	1-2	Patent On Advanced Manufacturing Technology	7
Vigilance Awareness Week	3-4	Past Events @ IPR	8
दो दिवसीय हिंदी सेमिनार	4	Upcoming Events	8
HPC Updates	5	Know Your Colleagues	8
IPR Outreach activities	6		
Development of Cryogenic Vacuum Barrier	7		

Help Fight The Covid-19 Pandemic



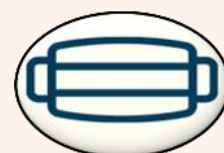
**Wash Your Hands
With Soap**

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



**Ensure Social
Distancing**

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



**Always Wear
Mask**

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



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