

Issue 102

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The Fourth State

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

2022
HAPPY NEW YEAR

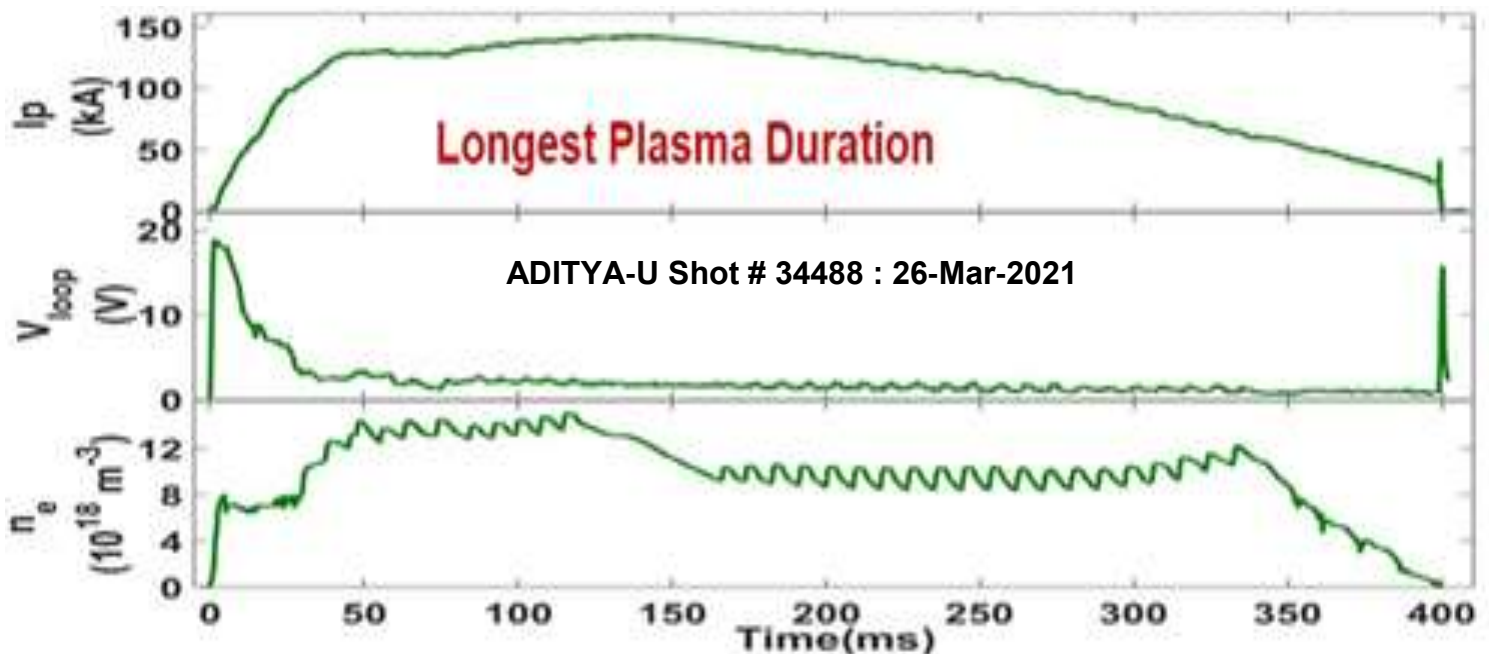
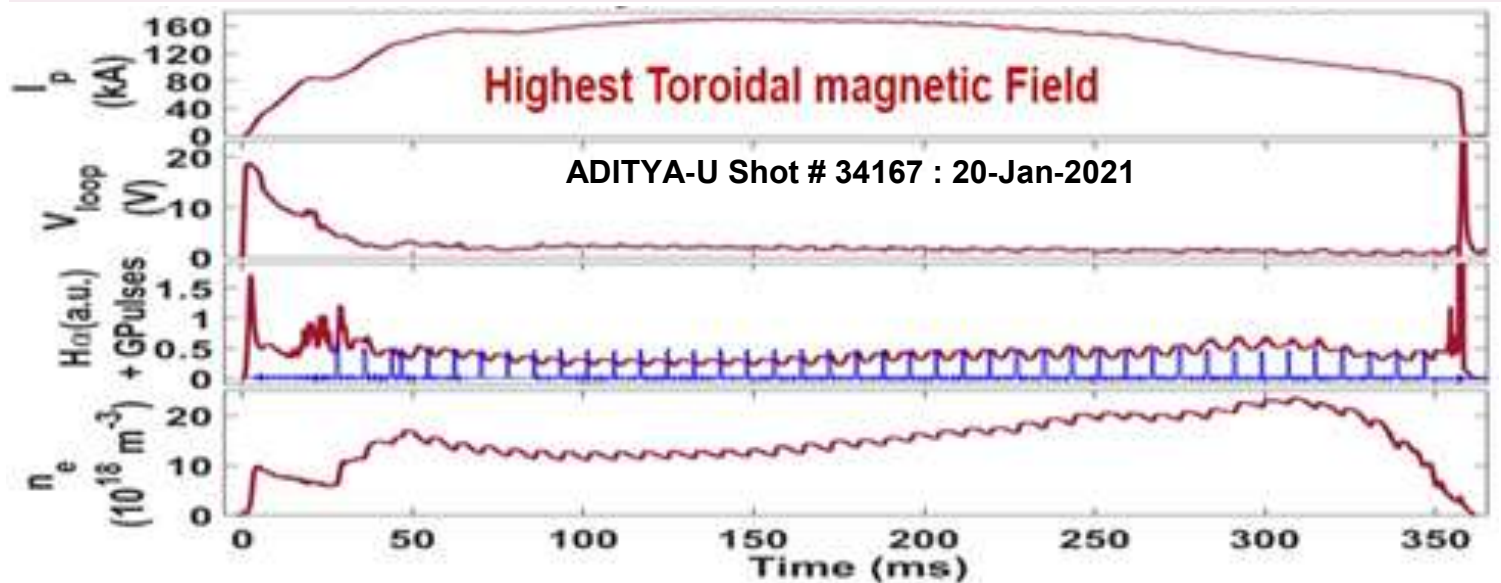
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Azadi Ka
Amrit Mahotsav

TECHNOLOGIES FOR
NEW INDIA @ 75

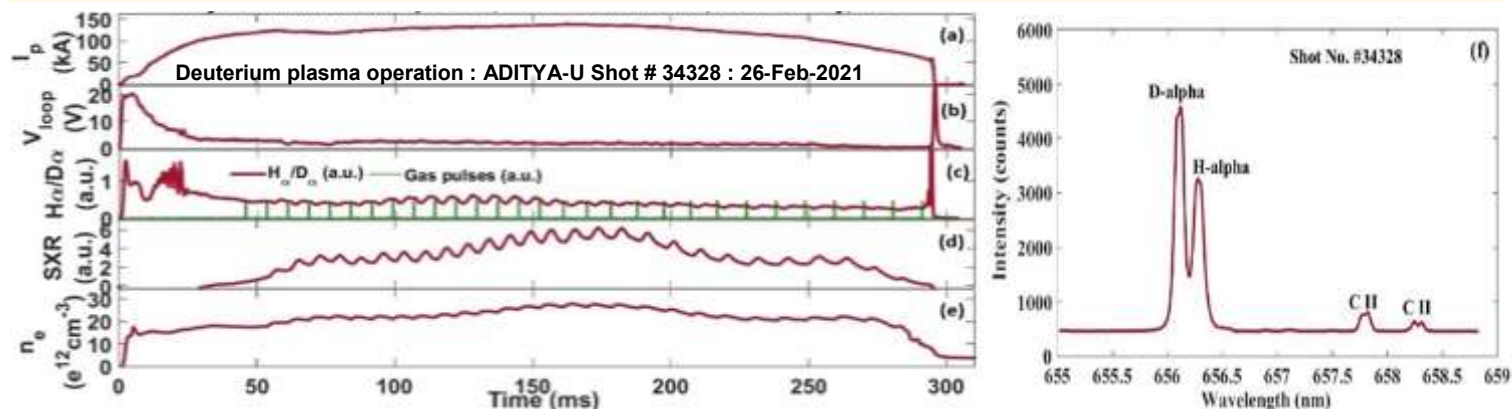
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आज़ादी का
अमृत महोत्सव

Activities of ADITYA-U Operations Division

The first Indian tokamak, ADITYA, an ohmically heated, air-core tokamak operated during the period from September 1989 to February 2015 with a circular poloidal limiter, has been upgraded to a tokamak named ADITYA Upgrade (ADITYA-U) to attain shaped-plasma operations with an open divertor without any baffle in single and double-null configurations. The disassembly of ADITYA tokamak and re-assembly of ADITYA-U took almost a year, followed by its commissioning and later the First Plasmas in ADITYA-U was established in December-2016 with the inclusion of new graphite toroidal belt limiter as the primary plasma-facing components. Last five years (January 2017 - December 2021), ADITYA-U operations have been mainly focused on realizing the plasma parameters close to the design parameters of circular plasmas in limiter configuration and also the initiation of shaped plasma operation. The maximum plasma parameters achieved in ohmically heated ADITYA-U limiter (toroidal belt-limiter) plasmas are: $I_p \sim 210$ kA, discharge duration (t) ~ 400 ms, chord averaged electron density (n_e) $\sim 6 \times 10^{19} \text{ m}^{-3}$, central electron temperature (T_{e0}) ~ 500 eV and stored energy (W) ~ 3 kJ. The machine is operated at a maximum toroidal magnetic field of (B_ϕ) ~ 1.5 T (100% of the design parameter) and edge safety factor (q_a) $\sim 3 - 4.5$.



To expand the operation horizon of the upgraded machine and to study the isotope dependency of confinement time, fully deuterium discharges are produced and studied. To ensure safety, Neutron Dose Rate Probes (Model LB 6411) have been used for ambient dose measurements of neutrons. One detector has been placed in ADITYA-U hall near to the radial port of vacuum vessel while the other detector in ADITYA-U control room. Neutron flux measured during D plasma experiment in ADITYA-U are found within the safe limit of operation. Consistent discharges with D gas as a fuel (pre-fill as well as gas puff - all are in D) have been obtained. Better confinement by a factor of 2 in D discharges in comparison to H plasmas are observed. The spectroscopy measurement of D-alpha line emission confirmed the D plasma. The presence of H-alpha emission is due to wall recycling as the wall is loaded with hydrogen from past discharges and also from GDC in Hydrogen.



The time evolution of ADITYA-U plasma discharge (#34328) parameters (a) Plasma current (kA), (b) Loop voltage (V), (c) H_α / D_α intensity (a.u.) and D gas pulses, (d) Soft X-rays intensity (a.u.), (e) chord average electron density (n_e) (cm^{-3}) and (f) Spectroscopic measurements of D-alpha line intensity along with H-alpha line intensity for D plasma experiments.

Further, to meet the objectives of the upgraded machine, plasma shaping experiments have been initiated in the bottom single null configuration. The bottom main divertor coil have been successfully charged up to $I_{div} \sim 7$ kA (42 kA turn) during the plasma current flat-top in several ADITYA-U discharges. The current pulse in the divertor coils starts at $t \sim 50$ ms applied during plasma current flat-top. In order to capture the initial modifications to the plasma column shape, a fibre-bundle based wide-angle fast visible imaging CCD camera is used, which covers the entire poloidal cross-section of the plasma and obtained images with high spatial and temporal resolution.



(a) Divertor plasma images for ADITYA-U shot #33665 compared with (b) simulation obtained with IPREQ.



Members of the Aditya Operation Division

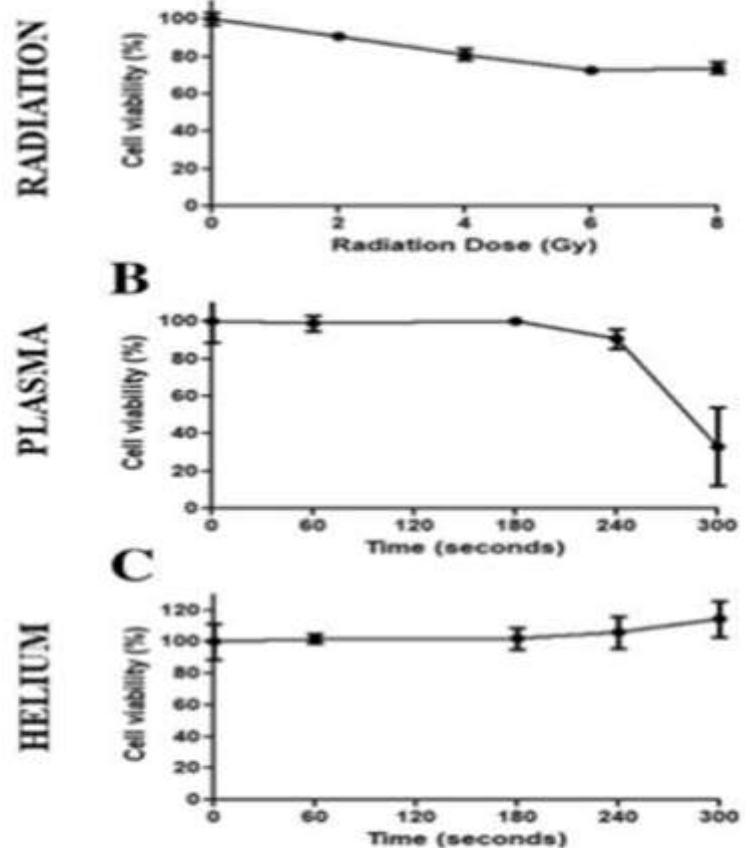
“तकनीक के साथ, विज्ञान की बात” कार्यक्रम श्रृंखला के तहत तीसरा व्याख्यान श्री **भरत दोशी**, वैज्ञानिक अधिकारी-जी द्वारा दिनांक 26.11.2021 को आईपीआर के सेमिनार हॉल में आयोजित किया गया और साथ ही इसे लाइव प्रसारित भी किया गया। श्री भरत दोशी, वैज्ञानिक अधिकारी-जी ने “**3D प्रिंटिंग तकनीक और इसके अनुप्रयोग**” (**3D Printing Technology and its Applications**) विषय पर बहुत विस्तार से चर्चा की। उन्होंने इस प्रौद्योगिकी की सृजन यात्रा को व्यापक रूप से समझाया और वर्तमान में इसके बढ़ते उपयोग पर भी चर्चा की। दोशी जी ने इस जटिल और महत्वपूर्ण विषय को हिंदी भाषा में बहुत ही सरलता से उजागर किया और इससे संबंधित वीडियो का भी प्रदर्शन किया गया। व्याख्या श्रृंखला को रोचक पूर्ण बनाने के उद्देश्य से प्रश्नोत्तर सत्र रखा गया, जिसमें वक्ता द्वारा श्रोताओं को इसी विषय के आधार पर कुछ प्रश्न पूछे गये जिसके उत्तर देने वाले श्रोताओं को पुरस्कृत किया गया।



सेमिनार हॉल में प्रश्नोत्तरी सत्र का आनंद लेते हुए श्रोतागण

Application of Cold Atmospheric Plasma Jet for Oral Cancer Treatment

IPR, in collaboration with the ACTREC, Tata Memorial Cancer (TMC) Mumbai, has studied the use of Cold Atmospheric Plasma (CAP) Jet on oral cancer cells. The active radicals generated in CAP Jet treatment have been found to have potent effect on cancer cells. The study has recently been published, “Effect of Cold Atmospheric Plasma Jet and Gamma Radiation Treatments on Gingivobuccal Squamous Cell Carcinoma and Breast Adenocarcinoma Cells”, in the journal Plasma Chemistry and Plasma Processing (2021). More detailed studies are in progress to see if this can become a new tool in the fight against cancer.



(L) plasma treatment of cancerous cells (R) Cell viability assessment using radiation, CAP jet and helium treatment on gingivobuccal cancerous cell at different time points.

A one-day Industry – Academia online meeting was organised on 3rd December 2021 by IPR under the auspices of “Azadi ka Amrit Mahotsav” to deliberate and disseminate latest developments in plasma based nanomaterials synthesis process and technology.

A total of 9 talks were delivered by field experts from R&D labs/Institutes (BARC, IIT-Gandhinagar, IPR), Universities (Bharatiyar Univ., Savitribai Phule Pune University) as well as Industry R&D heads (Plasvac, Saveer Matrix Nano). A total of 150+ participants had registered and participated in the online program. Participants included research scholars, senior scientists, industrial houses as well as young entrepreneurs interested in start-up companies. Dr. Shashank Chaturvedi, Director IPR, delivered the inaugural address.

Talks covered various aspects of thermal plasmas, torches used in material processing as well as synthesis of different types of materials and applications of some of the nanomaterials. Industry heads presented the commercial and business opportunities related to nanomaterials usage and also challenges facing by Indian industries in mass production of nanomaterials. These were deliberated. The final vote of thanks was delivered by Dr. S.K. Nema, Head, Atmospheric Plasma Division of IPR.



Images from PPNA-2021

The 36th National Symposium on Plasma Science & Technology (Plasma-2021) was organized by PSSI and BIT Mesra, Jaipur Campus during 13-15 December, 2021. This conference was conducted completely as an online event.

	Participants	Posters	Oral	Invited
IPR	124	92	07	02
CPP-IPR	04	04		-
ITER-India	15	14		01

The conference was inaugurated at BIT Mesra Jaipur campus and Prof. Prabhat Ranjan, Vice Chancellor, DYPIU, Pune delivered the Keynote Address. Dr. Shashank Chaturvedi, Director, IPR also addressed the participants. Dr. Devendra Sharma and Dr. Jinto Thomas of IPR and Shri Arun Chakraborty of ITER-India delivered invited talks in Basic plasma, Plasma Diagnostics and Fusion Technology sessions respectively.

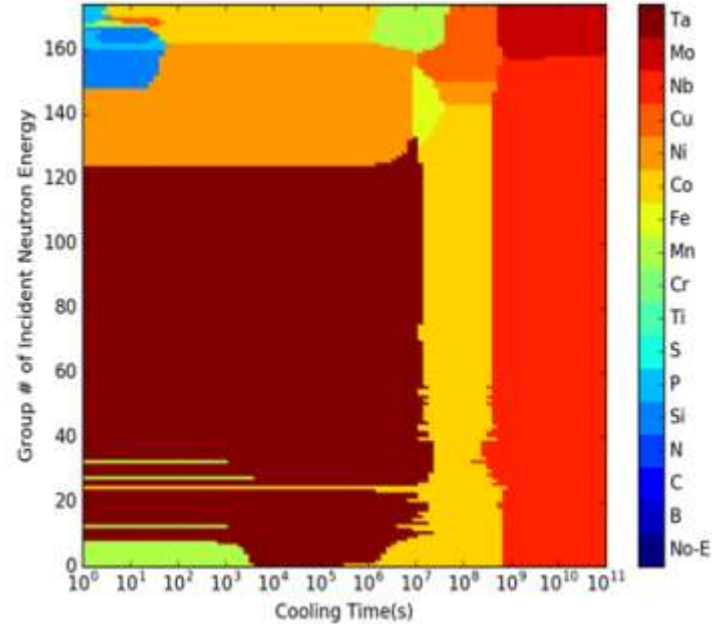
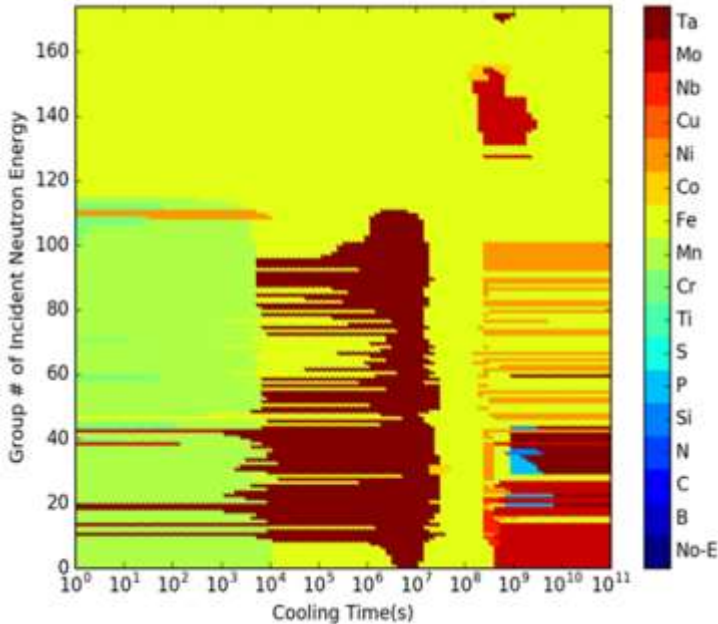


Top : Releasing the conference Abstract Book. Bottom (L) Dr Shashank Chaturvedi, Director, IPR (M) Prof. Indranil Manna, VC, BIT Mesra and (R) Shri V. K. Sharma, Director, MSME Development Institute, Jaipur addressing the online gathering during the inauguration of the conference.

Award	Name of the Recipient	Title of Abstract
Jaidutt Saraswati Sodha PSSI Plasma Award	Shantanu Karkari, IPR	For his significant research contributions through publications in reputed journals in plasma physics.
Buti Young Scientist Award	Hariprasad M. G., IPR	"First Order Phase Transition and Crystal-Fluid Coexistence in a Complex Plasma System"
Oral Presentation Award	Shishir Purohit, IPR	"Aditya tokamak plasma disruption characterization"
Poster Presentation Award	Tanmay Macwan, IPR	"Novel Explanation of the Cold Pulse Propagation Phenomenon Induced by Gas Puff in ADITYA-U Tokamak"
Poster Presentation Award	Mizanur Rahman, CPP	"Bulk Rate Synthesis Of Metal-Oxide Nanomaterials For Treatment Of Wastewater And Other Biomedical Applications"
Poster Presentation Award	P. N. Maya, IPR	"Overview of the Recent Investigations on the Surrogate-Particle-Irradiation in Tungsten Plasma-Facing-Materials"

ITER Approval for Indigenously Developed Computer Code for Nuclear Activation Analysis of Fusion Systems⁶

Rigorous and accurate nuclear analysis is required for nuclear fusion machines from design, safety, maintenance, material damage, and decommissioning and radiation waste (rad waste) disposal considerations. Two important classes of computer tools are necessary for a proper nuclear activation. As accessibility of nuclear activation to *Atmanirbhar Bharat*, IPR has developed an activation analysis called ACTYS. The ACTYS own first level material optimization module codes have been successfully validated against internationally-available benchmarks. Recently, the code has been approved by the Nuclear Integration Unit of ITER for all ITER-related nuclear activation calculations



(L) Relative contribution to the dose from each element of SS316L(N)-IG irradiated with ITER SA2 scenario with maximum flux $1\text{E}12\text{ n/m}^2/\text{s}$ and (R) The impact of each element to the total dose.

Features	ACTYS v1.0	FISPACT-2007
Incident particle	n	n,p,d
XS Data library	EAF2007/2010, FENDL/A3.1, Any ENDF-6 neutron XS file	EAF2007
Decay data library	Combination of EAFRDD, ENDF/B7.1 and JEF-F3.1.1	EAFRDD
Number of isotopes	3600	2220
Isomeric states and gas production	Yes	Yes
Multigroup XS	46,100,175 (pre-installed) Finer groups can be generated on demand	69,100,172,175,211,315,351 (pre-installed)
Flux weighing spectra	Flat, 1/E, fusion	Flat, fission, fusion
Doppler treatment	Yes (300, 600, 900 K)	No
Multi-level pathway generation	Yes	Yes, inaccurate, time-consuming
Sensitivity analysis	Yes	Yes, approximate
Rad-waste classification	ANDRA (French regulation) and clearance	Clearance
Material optimization	Yes	No

A one to one comparison of ACTYS with another code FISPACT, which is widely used among the fusion community. This code was also found to be faster than existing codes.

As part of the AKAM activities, IPR Outreach Division undertook several training programmes between 20-24 December, 2021 in “*Plasma & its Applications and Energy from Nuclear Fusion*” under the auspices of the Indian Science Congress Association, Bhubaneswar Chapter, for science teachers, research scholars and high school students of Kalinga Institute of Social Sciences (KISS-DU) and Kalinga Institute of Industrial Technology (KIIT-DU), Deemed Universities, Bhubaneswar. The training programme for teachers and students had popular talks and hands on exhibits of various types of plasma, its applications and models of a generic tokamak. Over 120 teachers and research scholars from KISS-DU and KIIT-DU, teachers and students from Trident Academy of Technology, College of Engineering & Technology, Bhubaneswar, Bhadrak Autonomous College, and P.N. College and Haladia College, Khordha also attended the programme. The programme was inaugurated by Prof. Asoka Das, ex-Scientist, BARC and currently Vice-Chairperson, Odisha State Higher Education Council. He also inaugurated the hands-on exhibition on plasma and its applications. The exhibition was also visited by Prof. B.B. Mishra, President of Odisha Vigyan Academy (Dept of S&T, Govt of Odisha). A special session for research scholars was also held at Ravenshaw University, Cuttack on 23rd December. The programme was coordinated by Dr. Kajal Parashar of KIIT-DU, and Convener, ISCA, Bhubaneswar Chapter.

Talks and hands-on experiments were delivered by members of IPR Outreach Division. 14 experiments/exhibits were transported to Bhubaneswar from IPR for this event. Over 600 tribal students studying in the 9, 10, 11 and 12th standards of KISS-DU also attended a special lecture on plasma and spent time interacting with IPR Outreach staff and the interactive experiments.



Images from the AKAM training programme organized by IPR at the KIIT-DU and KISS-DU, Bhubaneswar.



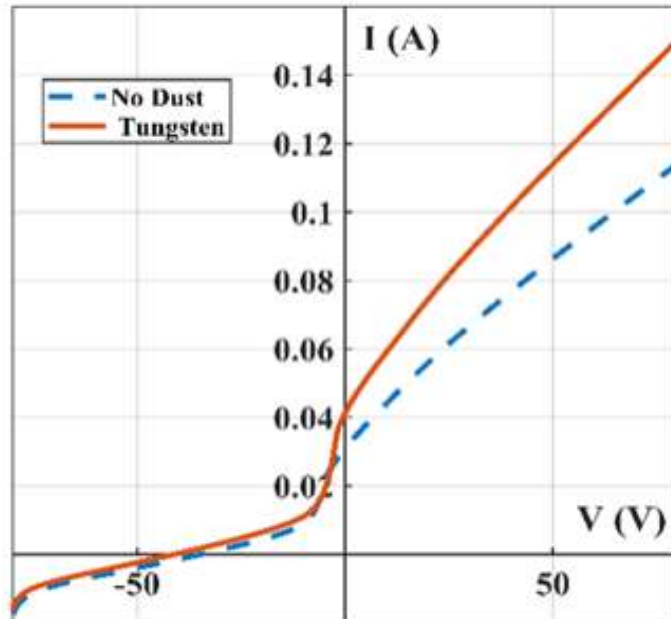
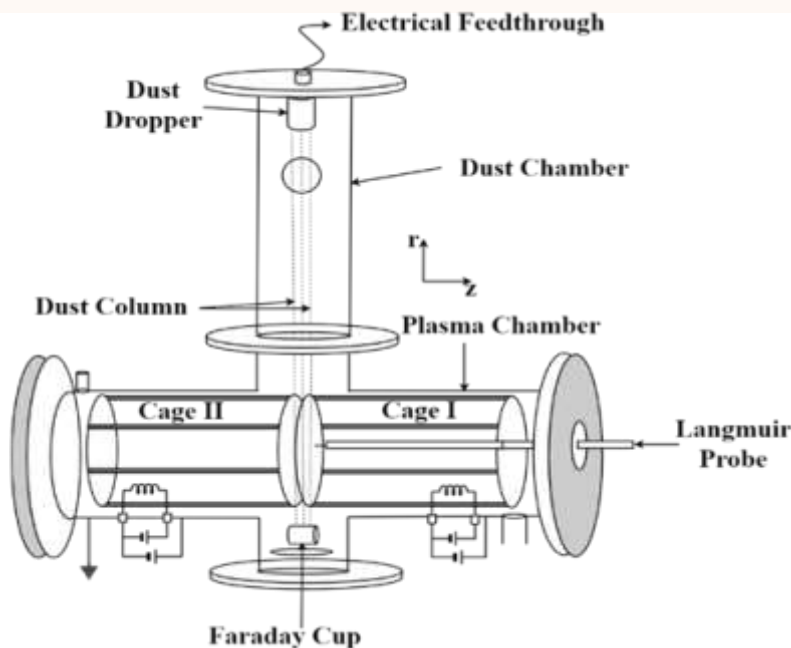
Images from the AKAM training programme organized for teachers by IPR at the KIIT-DU and KISS-DU, Bhubaneswar.

A special training session on plasma & its applications was arranged for the students and researchers of Ravenshaw University, at Cuttack on 23rd December. Due to a special request from doctors from the Kalinga Institute of Medical Sciences (KIMS) as well as Kalinga Institute of Dental Sciences (KIDS), a special talk on "Biomedical Applications of Plasma" was delivered by Dr Ravi A V Kumar on 24th Dec, 2021. The doctors who attended the talk also visited the hand-on exhibits.



Students from KISS-DU, Ravenshaw University and Doctors of KIMS attending the AKAM training programme

Dusty plasmas have always been a fascinating field of research as it capable of explaining the astrophysical phenomena in laboratory scale. Additionally, it also finds application in the industrial field as well. Dust grains of various shapes and sizes are also encountered in tokamaks and are often regarded as contaminants. It becomes essential to understand the charging mechanism to remove them from the fusion devices. The present experiment aims at understanding the charging behaviour of dust grains in a two temperature electron plasma system as shown in Figure 1. The plasma parameters replicate that of the divertor region of COMPASS tokamak. Three types dust samples were used in this study. It was observed that with the introduction of dust, the overall electron saturation current in the I - V curve increases as shown in Figure 2. This indicated that an additional source of electrons is being generated in the system. The calculated Electron Energy Distribution Function from the I - V curve shows that there is an increase in the lower energetic electron population indicating electrons are being emitted from the dust surfaces. This is also in consistence with the electrometer readings that depicts a decrease in the negative charge on the dust grains. To our knowledge, secondary electron emission from tungsten (W) dust surface in the energy range of 60 - 100 eV is observed for the first time in a low pressure laboratory plasma. A team comprising of Ms. Rupali Paul, Mr. Gunjan Sharma, Mr. Kishor Deka, Dr. R. Moulick, Dr. S.S. Kausik, Prof. B.K. Saikia from CPP-IPR and Dr. S. Adhikari (University of Oslo, Norway) was associated with this work.



(L) Schematic diagram of the experimental setup. (R) I - V curve in presence and absence of W dust.

Communal Harmony Campaign Week 2021 @ IPR

Communal Harmony Campaign Week & Flag Day 2021 was observed at IPR during 19-25 Nov 2021. To spread the message of Communal Harmony, various activities were carried out through-out the week. Essay Writing and Poem competitions on the theme "Communal Harmony for National Development" were conducted. A Webinar talk on "सांप्रदायिक सद्भाव और राष्ट्रीय एकता" by Dr. Ramgopal Singh, Prof. & Head, Hindi Department, Gujarat Vidyapeeth was arranged on 23 Nov 2021.

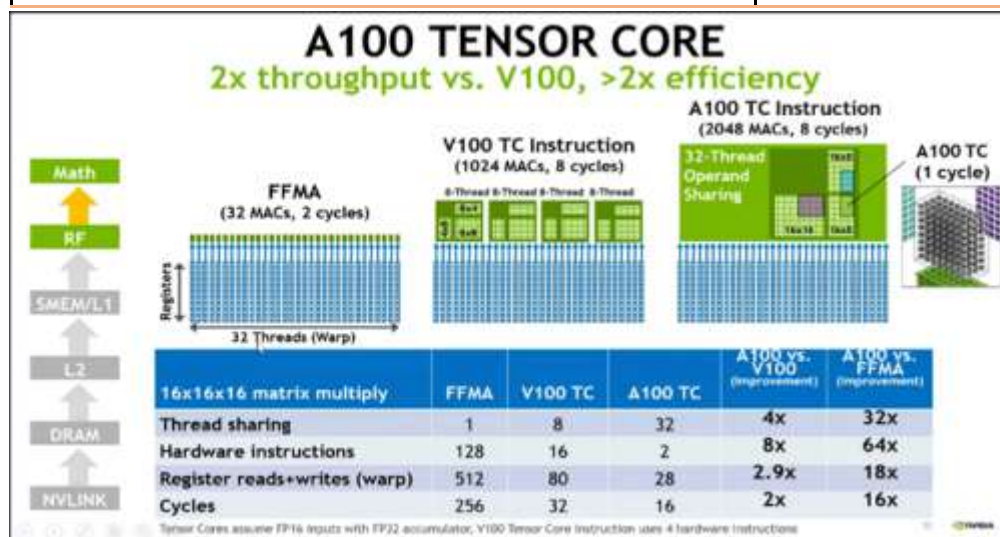
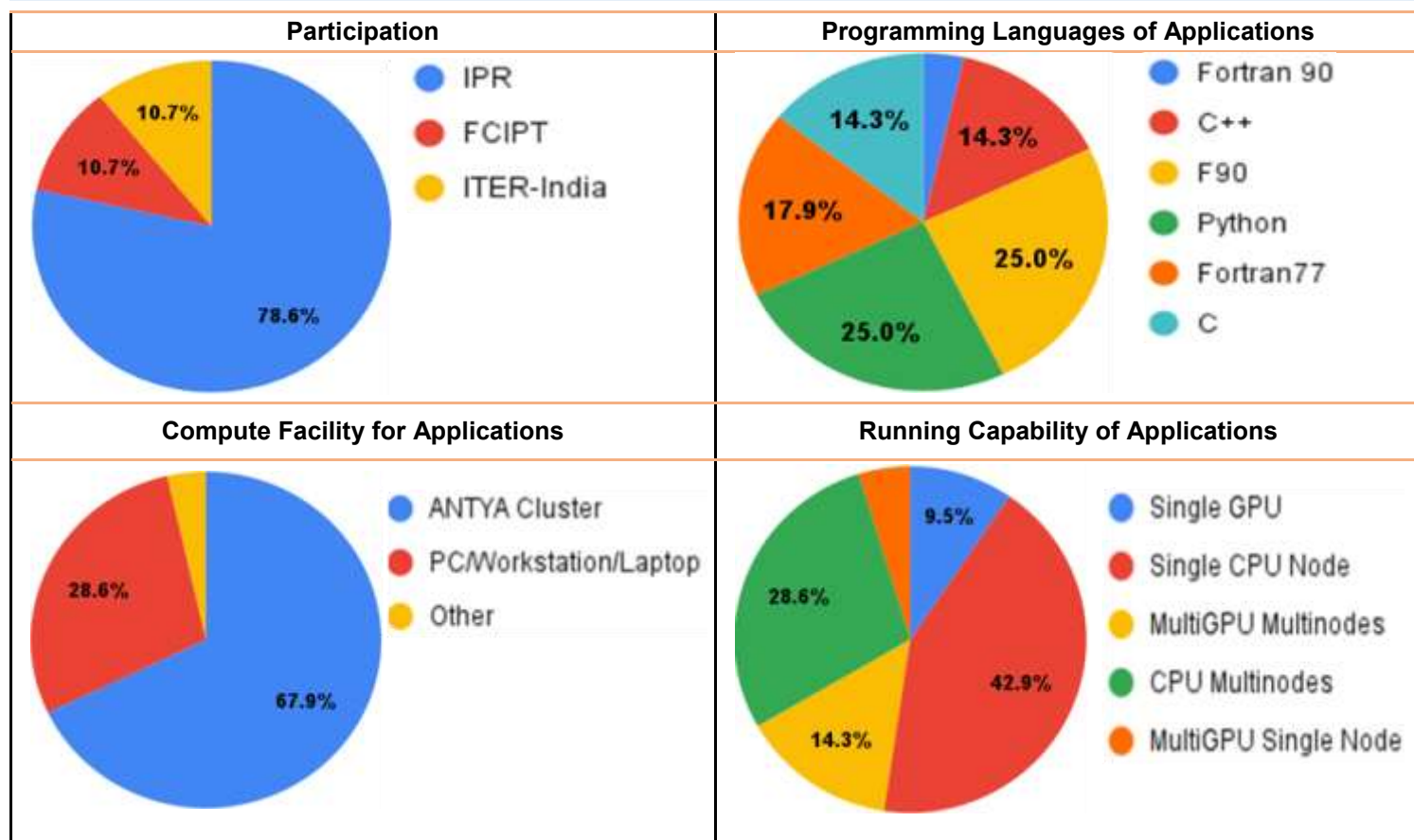
Flag Day was observed on 25 November 2021 where the staff were encouraged to come in traditional attire and flag stickers were distributed among the staff. A voluntary fund raising campaign was also carried out by keeping donation boxes in IPR, FCIPT and ITER-India campuses.



With the ongoing effort to efficiently utilize the GPUs and make our in-house developed applications/codes ready for the emerging computational architectures, HPC Team of IPR, along with the help from Nvidia Team conducted this 2-Half day GPU Bootcamp virtually on 20-21 October 2021. No GPU programming knowledge was required for the participants. All the participants were given access to IPR's 1 PetaFlop HPC Cluster, ANTYA for carrying out the hands-on lab sessions. Day-1 started with an introduction to GPU programming using OpenACC, stdpar, Fortran Do-Concurrent, and a hands-on session to learn how to analyze GPU-enabled applications.

For the lab sessions, a demonstration was shown on how to launch a "headless" Jupyter Notebook as a batch job in ANTYA and access the Graphical User Interface (GUI) in the Local user machine's (Desktop/Laptop) web browser. Day-2 focussed on the latest GPU architecture, how to run Python on GPUs (CUDA Python), and the newly emerging PINN (physics-informed neural network) approach using NVIDIA SimNet (an AI-driven multi-physics simulation framework). This process gave the participants insight into how GPUs can be used in their applications and how they can start using them from scratch. The level of engagement of the participants with the trainers showed their enthusiasm and eagerness to learn GPU programming and its application to accelerate their work.

During the 1st GPU Bootcamp, many good quality In-house developed codes (serial as well as parallel) spanning Computational Fluid Dynamics (CFD), Molecular Dynamics (MD), Particle-in-Cell (PIC), etc. domains have been ported successfully and achieved initial performance enhancement as shown in the number of applications registered for 2nd Bootcamp. This Bootcamp brought together more than 25 participants for two half-days from various divisions in IPR, FCIPT and ITER-India having expertise with different domains/programming languages.



The new batch of IPR Trainee Scientific Officer (ITSO) joined at IPR during the second/third week of December 2021. This batch comprises of total 08 Nos. of students from Physics, Electronics, Computer and Electrical Engineering Disciplines. These students will undergo OCES-2021 course work at BARC Training School, Mumbai followed by project work at IPR as a part of Trainee Scientific Officer Training programme. After joining at IPR, their orientation programme started with an overview talk by Director, IPR and training programme overview by concerned persons from Administration and HRMC. This was followed by visits to various experimental set-ups (SST-1, Aditya), R&D Labs, FCIPT etc. The necessary arrangements for their training at BARC and IPR have been planned and coordinated by team from Administration, HRMC and the IPR Academic Committee. This team will be coordinating ITSOs training activities and logistics arrangement with the help of HRD Division, BARC and the OCES-2021 training programme. This one year training programme for ITSOs will start from 27-Dec-2021 at BARC, Mumbai with two semesters course work and later-on ITSOs will undergo one semester project work at IPR. We heartily welcome the new members of IPR Family !



Dr. Shashank Chaturvedi addressing the new ITSO officers



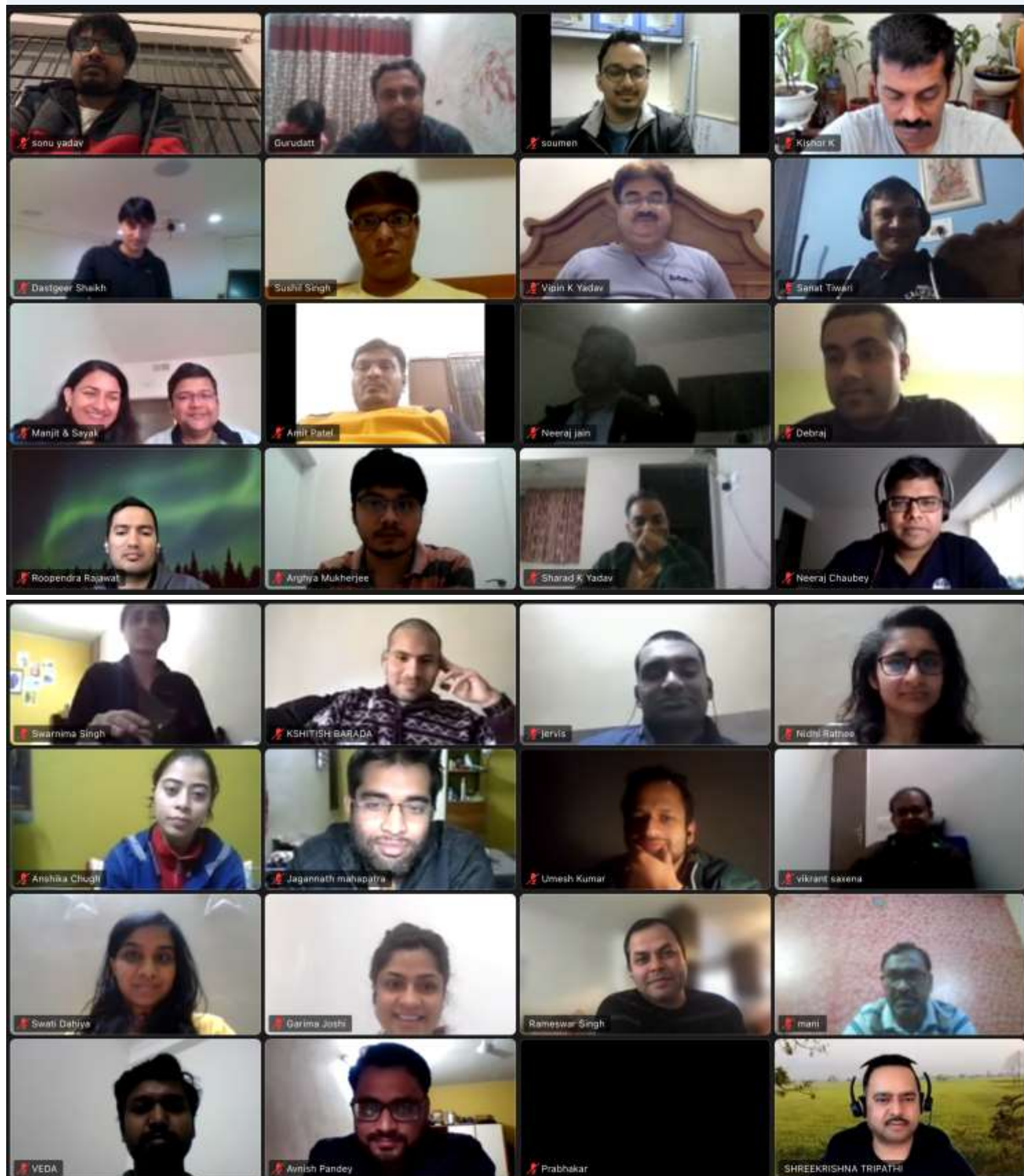
Mr. Amit Srivastava addressing the new ITSO officers



The ITSO officers who joined IPR

Past and Current Scholars met virtually for the second IPR Research Scholars' Reunion on December 26, 2021. The objective of the event was to connect with one another and to discuss the opportunities to act as the volunteers, mentors, employers, ambassadors, collaborators to support each other and students of IPR. The alumni scholars reminisced and shared the stories from IPR days along with the various job and collaboration opportunities available for the current scholars in Academia as well as Industry. The current scholars update about life, in general, at IPR.

The participants included Shreekrishna, Dastgeer, Deepak, Mani, Ganesh, Vipin, Neeraj Jain, Rajneesh, Vikrant, Kishor, Sharad, Gurudatt, Rameswar, Sanat, Kshitish, Sushil, Manjit, Sayak, Veda, Neeraj Chaubey, Meghraj, Akanksha, Roopendra, Arghya, Umesh, Amit, Prabhakar, Debraj, Pallavi, Jervis, Sonu, Soumen, Mayank, Garima, Swarnima, Anshika, Nidhi, Jagannath, Swati, Suruj, Pranjal, Shirish, Avnish, and Pawandeep.



Online meeting of IPR alumni

- ◆ **Talks presented at 63rd Annual Meeting of the American Physical Society (APS) Division of Plasma Physics, 8-12th November 2021**
 - **Mr. Shivam Mishra**, gave a talk on "Effect of radiation-reaction on charged particle motion in an intense focused light wave"
 - **Ms. Devshree Mandal**, gave a talk on "Electromagnetic Transparency in strongly magnetized plasmas"
 - **Dr. Nirmal K Bisai**, gave a talk on "Theory of plasma blob formation and its experimental validation"
 - **Mr. Akash Garg**, gave a talk on "Effects of transmutations in material damage for plasma-facing materials in fusion systems"
 - **Mr. Abhishek Saraswat**, gave a talk on "Experimental investigations on electrical-insulation performance of Al_2O_3 coatings for high-temperature lead-lithium liquid-metal applications"
 - **Mr. Deepak Sharma**, gave a talk on "Design and analysis of a plasma chamber for thermal processing applications"
- ◆ **Mr. Upendra Prasad**, gave a talk on "Fabrication and Characterization of BSCCO-2223 Tape Based Compact Coils" at 27th International Conference on Magnet Technology, Fukoka, Japan, on 15-19 November 2021
- ◆ **Mr. Nitin Bairagi**, gave a talk on "Preliminary design and analysis of 20 K helium cooled MgB_2 based superconducting current feeder system for Tokamak application" at 27th International Conference on Magnet Technology (MT27), Fukuoka, Japan, on 18th November 2021
- ◆ **Dr. Sarveshwar Sharma**, gave an invited talk on "Plasma: Key Tool for Energy Production and Industrial Applications" at National Webinar Series by Department of Physics on the Theme of Physics in Social Development, University Maharani College, Jaipur, on 20 November 2021
- ◆ **Mr. Darpan Bhattacharjee**, gave a talk on "A Table-top Neutron/X-ray Source for Near-term Applications" at International Conference on Advances in Physics and its Applications (APA2021), Duliajan College, Assam, 26-27th November 2021
- ◆ **Dr. Razia Nongjai**, Inter University Accelerator Centre (IUAC), New Delhi, gave a talk on "Defects related structural, electrical, optical and magnetic properties of metal oxides thin films" on 2nd December 2021
- ◆ **Dr. Gaurang Joshi**, gave a talk on "Development of Dissimilar Weld Joints of Ferritic and Austenitic Steel for Test Blanket Module (TBM)" on 6th December 2021
- ◆ **Mr. Avnish Kumar Pandey**, gave a talk on "Non-Neutral Sheath region around surfaces In Low Temperature Plasma containing Negative ions" on 07th December 2021
- ◆ **Mr. Shivam Kumar Mishra**, gave a talk on "Radiation Reaction Effects on Laser Driven Acceleration of Charged Particles" on 13th December 2021
- ◆ **Dr. Tejendra Patel**, gave a talk on "Heat Transfer Analysis of PINI Ion Source Back Plate Using ANSYS" on 16th December 2021
- ◆ **Dr. Prateek Varshney**, gave a talk on "Terahertz Emission Using Laser Plasma Interaction" on 17th December 2021
- ◆ **Dr. Anshu Verma**, Indian Institute of Technology Delhi, gave a talk on "Exploring Thruster Potential of Compact ECR Plasma Source" on 22nd December 2021
- ◆ **Mr. Vivek Pachichigar** (SRF) gave an oral presentation entitled "Wettability studies on PTFE surfaces using argon plasma" in the Virtual National Conference on Plasma Science and Applications (PSA-2021, 20-21/12/2021) organized by SVNIT, Surat and PSSI. He was awarded the best oral presentation award for this.

Upcoming Events

- ◆ Applications of Radiation and Nuclear Technologies for Societal Benefits (*Hindi Webinar*), Indira Gandhi Centre for Atomic Research, Kalpakkam, 10-11 January 2022. <http://www.igcar.gov.in/seminars/>
- ◆ IGD-TP Symposium and Webinar: The Role of Optimisation in Radioactive Waste Geological Disposal Programmes, Switzerland, 11-13 January 2022. <https://igdtp.eu/event/igd-tp-symposium/>
- ◆ H-mode transition and pedestal studies in fusion plasmas, Online event, 17-19 January 2022. <https://royalsociety.org/science-events-and-lectures/2022/01/fusion-plasmas/>
- ◆ Burning Plasma Concepts Webinar Series (USBPO): Burning Plasma Aspects and Reactor concept with a Steady State Tokamak, Virtual, 20 January 2022. https://burningplasma.org/resources/ref/USBPO_BurningPlasma_Info_WebinarSeries_announce.pdf
- ◆ 42nd Workshop on High-Energy-Density Physics with laser and Ion beams, Hirschegg, 31 January - 4 February 2022. <https://indico.gsi.de/event/13376/>

Know Your Colleague



Mr. L.N. Srikanth joined IPR as an Engineer-SC in May 2008 in the SST-1 Cryogenics division. Initially, he contributed to the operations of SST-1 cryogenic system and the cool down campaigns of 80K thermal shields, TF magnets and 5K shields of TF Coils. He later worked on design and development of vacuum insulated transfer lines for liquid helium and liquid nitrogen applications, installation & commissioning of 80K valve boxes, up gradation of integrated flow distribution & control (IFDC) system of cryogenics plant.

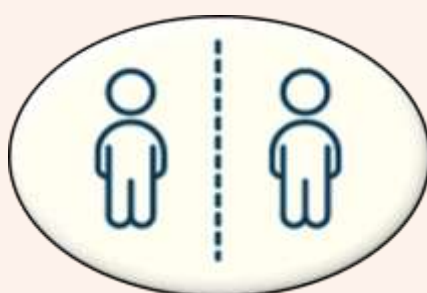
He has hands-on skill and expertise in the alignment of helium screw compressors with electrical motors. He is one of the active member involved in the operation of SST-1 cryogenics plant. Presently, he is looking after the Inventory of LN₂, SMPV rule 18 and rule 19 tests of helium and liquid nitrogen storage vessels and their license renewal work and also one of the team member of SST-1 cryogenics plant activities. As a part of academics he supervised graduate and summer school students.

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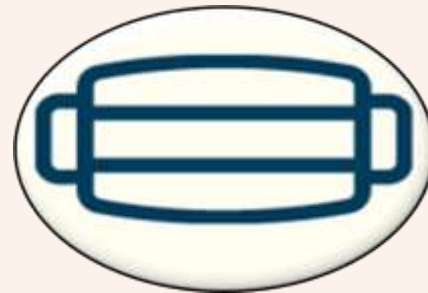
Help Fight The Covid-19 Pandemic



**Wash Your Hands frequently
With Soap**



**Ensure Social Distancing
At ALL times**



**Always WEAR a Mask
When you go outside**

- ◆ 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

- ◆ 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.

**Please get yourselves vaccinated
against Covid-19**

**कृपया अपने आप को कोविड -19 के
खिलाफ टीकाकरण करवाएं**

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

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