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The 4th State

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

SST-1 Update - Long Pulse Discharges With LHCD

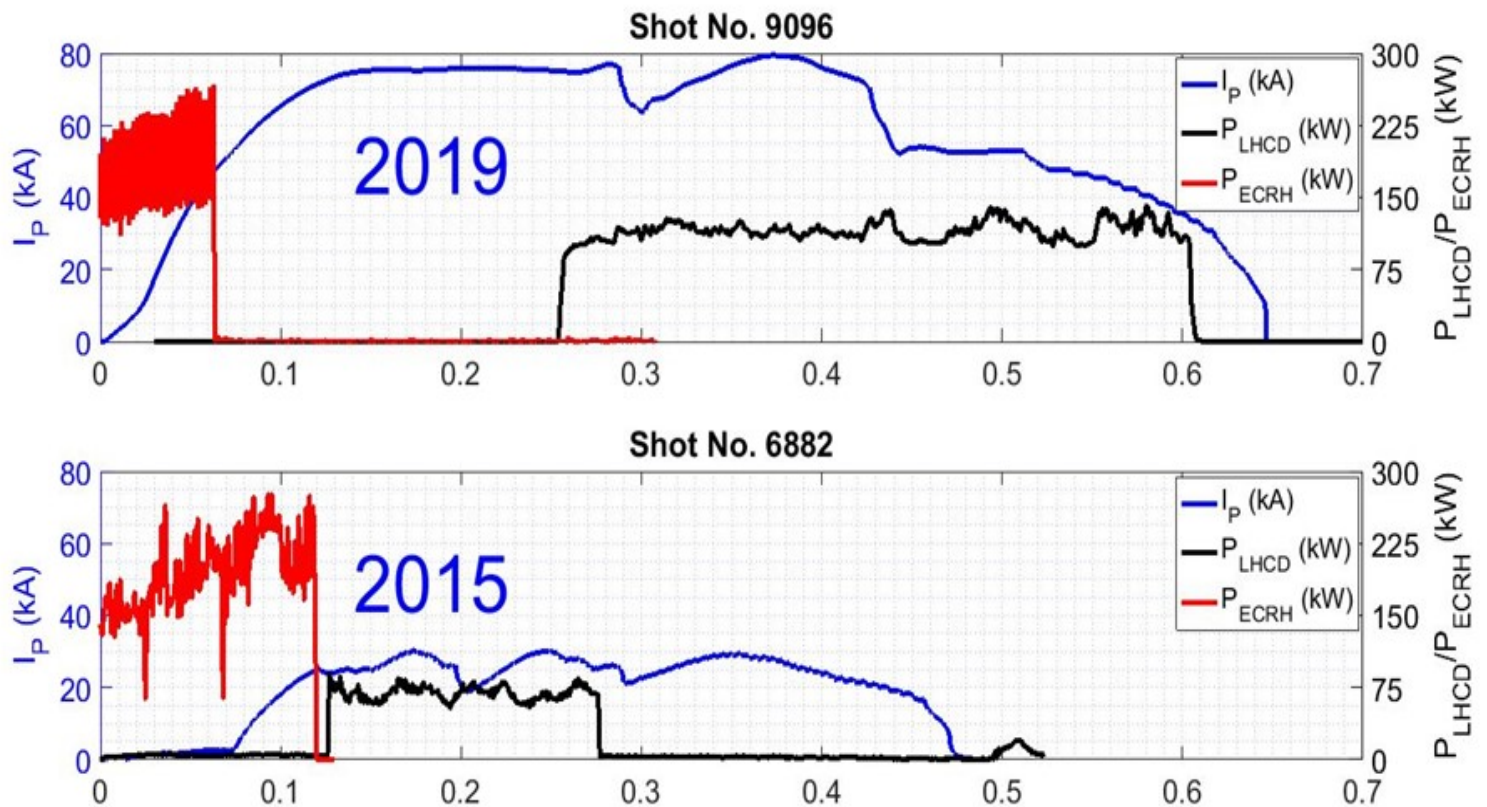
In the recently completed campaign (XXIV) of the Steady-state Superconducting Tokamak-1 (SST1), held in April-2019, a new milestone of the longest plasma discharge of **~650 millisecond** was achieved. The plasma current was sustained non-inductively and assisted by lower hybrid waves (LHWs) launched from lower hybrid current drive (LHCD) system.

This achievement surpassed the earlier long pulse plasma shot of ~480 ms obtained in 2015, assisted by the LHCD system. The two pulses are shown below for easy comparison and displays distinguished features which are discussed below.

As can be inferred from the figure, the LH coupling was obtained at higher plasma current (~75kA), compared to earlier campaign (~25kA). As plasma density was also high in this campaign, it provided better edge plasma conditions for efficient coupling of LHWs from the launcher to the plasma. Also, in the present campaign, the entire loop voltage could be utilized and nearly zero loop voltage conditions were obtained in the shots which was not the case in earlier campaigns.

Earlier, (in 2015 campaign), the target plasma was formed with the help of Ohmic system and the electron cyclotron resonance heating (ECRH) system (used for pre-ionization) simultaneously. To sustain the plasma current non-inductively, the LH pulse of 150ms was injected, immediately after the ECRH pulse. It is worth noting that in the present campaign, a very short pulse of ECRH could pre-ionize the plasma and later Ohmic power supported the formation of target plasma. Once a good target plasma was formed, the LHCD pulse was injected after sufficient delay of 200ms.

These improved conditions provided encouraging results in the present campaign and will help in planning the next campaign.



(Top) The record long pulse discharge in SST1 for ~650msec, obtained in the 24th experimental campaign (Bottom) Earlier long pulse discharge with LHCD in SST1 machine from a campaign in 2015

The **Vigyan Samagam**, India's first mega science exhibition kicked off on 7th May, 2019 at the Nehru Science Center, Mumbai. The exhibition was inaugurated by Dr. Vijay Kumar Saraswat, Member, Niti Aayog. The exhibition was also thrown open to public. On 7th and 8th May, speakers from all of the mega projects gave presentations. From IPR, Dr. Shashank Charurvedi, Director, gave a talk on "*India's Plasma Science & Technology Program and Spin-offs*", Dr. Laban Coblenz, Head, Communications, ITER, France, gave a talk on "*The ITER Project: 'the way' to new energy*" and Shri Ujjwal Baruah, Project Director, ITER-India gave a talk on "*India's participation in ITER – Technology challenges and Industry response*". For LIGO India, Prof. S. Mukherjee gave a talk on "*LIGO India - opportunities for the industry*".

This was followed by a Panel Discussion on "*Leveraging collaboration for Indian science and industry*", which was moderated by Shri Arun Chakraborty of ITER India. The participants of this discussion were Dr. K., Balasubramanian (Director, NFTDC, Hyderabad), Prof. Rajiv Dusane (P. K. Kelkar Chair Professor in Nanotechnology, IIT Bombay), and Mr. Rajkumar Panjwani (President, Cryo Scientific Division, INOX India Pvt. Ltd).

This exhibition will be open to public at Mumbai till 7 July, 2019. IPR / ITER-India week at this exhibition will be from 20-26 May, 2019.



(Top) Dr. V. K Saraswat inaugurating the Vigyan Samagam (Middle) Releasing the exhibition booklet (Bottom) ITER stall at the exhibition



(L-R) Dr. Shashank Chaturvedi, Shri Ujjwal Baruah and Prof. S Mukherjee delivering their talks



(L) Shri Arun Chakraborty conducting the panel discussion. (R) Children interacting with the exhibits at the ITER stall



Children at the ITER exhibition



(L) Dr. Shashank Chaturvedi interacting with Dr. Anil Kakodkar, Dr. Laban Coblentz and Shri Vithal Nadkarni (R) ITER Stall

आईपीआर की राजभाषा कार्यान्वयन समिति द्वारा दिनांक 7 मई, 2019 (मंगलवार) को तकनीकी/वैज्ञानिकी विषय पर एक दिवसीय हिन्दी सेमिनार का आयोजन किया गया। सेमिनार में दी गई प्रस्तुतियों का विवरण निम्नलिखित है:

नाम	विषय
श्री रितेश सुगंधी	SYSLOG का परिचय /Introduction to SYSLOG
श्रीमती ज्योति अगरवाल	डाईइलेक्ट्रिक बैरियर डिस्चार्ज प्लाज्मा और इसके उपयोग / Dielectric barrier discharge plasma and its application
श्री कनुभाई परमार	ई सी आर एच प्रणाली /ECRH System
सुश्री यशश्री पाटिल	जड़त्वीय संलयन ऊर्जा और उसका विकास / Inertial fusion energy and its development
श्री राजीव शर्मा	वैक्यूम जैकेटेड फ्लेक्सिबल क्रायोजेनिक ट्रांसफर लाइन का स्वदेशी विकास / In-house development of vacuum jacketed flexible cryogenic transfer line
श्री देवेन्द्र मोदी	आप कार्यस्थल पर कितने सुरक्षित है? / How safe are you at the workplace?
श्री गट्टू रमेश	इलेक्ट्रोमैग्नेट्स के कारण चुंबकीय क्षेत्र के लिए एक कोड / A code for magnetic field due to arbitrary electro-magnets
श्रीमती सुतापा रंजन	कृत्रिम बुद्धि बनाम मानव बुद्धि / Artificial intelligence vs human intelligence
श्री डिकेंस क्रिश्चियन	रोजमर्रा के काम में विद्युत सुरक्षा / Electrical safety in everyday work
श्रीमती छाया चावड़ा	आईपीआर की आउटरच गतिविधियाँ outreach activities of IPR
श्री भरत दोशी	आईपीआर वर्कशॉप का परिचय और आईपीआर के अनुसंधान और विकास कार्यक्रम में इसका योगदान Introduction to IPR workshop and its contribution towards IPR's R&D programme

सभी प्रतिभागियों ने पूरे उत्साह के साथ संबंधित विषय पर अपनी प्रस्तुति दी और श्रोताओं के संदेह दूर किये। प्रत्येक प्रस्तुतिकरण के बाद श्रोताओं के लिए प्रस्तुतिकरण से संबंधित प्रश्नोत्तरी प्रतियोगिता का भी आयोजन किया गया। सेमिनार के दूसरे सत्र के समापन के बाद श्री राजसिंह, उपाध्यक्ष, राभाकास ने सभी प्रतिभागियों को तकनीकी विषय को रोचकता से हिंदी में प्रस्तुत करने हेतु बधाई दी और साथ ही भविष्य में इस प्रकार के आयोजन में तकनीकी विषय को सरल हिंदी भाषा में अभिव्यक्त करने हेतु उपस्थित सभी पदाधिकारियों को प्रोत्साहित किया।

डॉ. सूर्यकांत गुप्ता एवं डॉ. विपुल तन्ना ने इस सेमिनार के प्रस्तुतिकरणों का मूल्यांकन किया। श्रीमती सुतापा रंजन, श्री गट्टू रमेश एवं श्री डिकेंस क्रिश्चियन को प्रथम पुरस्कार, श्री राजीव शर्मा, सुश्री यशश्री पाटिल एवं श्री रितेश सुगंधी को द्वितीय पुरस्कार एवं श्री देवेन्द्र मोदी, श्री कनुभाई परमार एवं श्रीमती छाया चावड़ा को तृतीय पुरस्कार तथा श्री भरत दोशी एवं श्रीमती ज्योति अगरवाल को प्रोत्साहन पुरस्कार प्रदान किये गये।

राजभाषा के क्षेत्र में उत्कृष्ट कार्य हेतु इस अवसर पर पिछली छमाही (जुलाई-दिसम्बर, 2018) के लिए अंतर अनुभागीय चल राजभाषा शील्ड लेखा अनुभाग को प्रदान की गई है एवं अनुभाग के सदस्यों को पुरस्कृत किया गया। लेखा अनुभाग के अथक प्रयास स्वरूप टैली सॉफ्टवेयर के सभी वाउचर हिंदी में जनरेट किये जा रहे हैं, जो कि एक विशेष उपलब्धि है। अंत में सभी को धन्यवाद देते हुए कार्यक्रम का समापन किया गया।





(L) श्रीमती छाया चावड़ा और (R) श्री गट्टू रमेश अपने व्याख्यान देते हुए।



हिंदी सेमिनार में उपस्थित दर्शक

Fire Service Week-2019 @ IPR

Fire Service Week is observed every year to enhance general public awareness about the necessity of minimizing losses due to fire. 14th April is also observed as the "Martyrs Day" in homage to those brave firefighters who sacrificed their lives while discharging their duties. The Ministry of Home Affairs, Govt. of India, had decided the theme of "Fire Prevention is better than Fire Fighting" for this year. In view of this, IPR observed the "Fire Service Week" by conducting short briefing session at various work areas on "*how to prevent fire and how to operate fire extinguishers*". Furthermore, practical demonstration of operation of fire extinguishers was conducted for the workshop team members, employees, security personnel, guest house staff, etc. The security personnel at ITER-India laboratory building were also shown the demonstration of fire hydrant system.



(L) Demonstration of the fire fighting system for the security personnel (R) Demonstration of fire extinguishers by the employees

Visit of Students of ISRO's "YUVIKA" Young Scientist Programme

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The school students from the north and western regions of India, selected for ISRO's "Young Scientist Programme" "YUva Vigyani Karyakram" visited IPR on 15 May 2019, in tune with the Government's vision "Jai Vigyan, Jai Anusandhan". The program is aimed at creating awareness amongst the youngsters who are the future building blocks of our Nation. ISRO has chalked out this programme to "Catch them young". Thirty three of the 128 students selected this year visited IPR as part of the programme.

Director IPR addressed the participants of the programme and gave a popular talk on IPR activities, with emphasis on societal applications of plasma. Outreach Division had also arranged interactive plasma experiments for the visiting students. The students were also taken to see Aditya and SST-1 machines.



(Top) Director IPR giving his popular talk (Middle) Participants with Director IPR (Bottom) Participants at the technology Park

नगर राजभाषा कार्यान्वयन समिति की बारहवीं छमाही बैठक 26 अप्रैल, 2019 को बड़ौदा एपेक्स अकादमी, गांधीनगर में आयोजित की गई, जिसमें श्री पंकज जानी, नराकास अध्यक्ष एवं प्रमुख, बड़ौदा एपेक्स अकादमी, श्रीमती सुनीता यादव, उपनिदेशक, क्षेत्रीय कार्यान्वयन कार्यालय, मुंबई एवं गांधीनगर स्थित केन्द्र सरकारी कार्यालयों/उपक्रमों/बैंकों/संस्थानों के प्रमुख एवं प्रतिनिधि उपस्थित थे। इस बैठक में राजभाषा के क्षेत्र में श्रेष्ठ कार्यनिष्पादन हेतु वर्ष 2018 के लिए **प्लाज्मा अनुसंधान संस्थान** को **प्रथम पुरस्कार** के रूप में शील्ड और प्रमाणपत्र प्रदान किया गया। प्लाज्मा अनुसंधान संस्थान की ओर से उपस्थित आईपीआर के सदस्यों ने यह पुरस्कार ग्रहण किया। पुरस्कृत कार्यालयों में राजभाषा संबंधी कार्यों से जुड़े कर्मचारियों को उनके उल्लेखनीय योगदान के लिए पुरस्कार दिया गया। डॉ. संध्या दवे को कार्यालय में राजभाषा कार्यान्वयन में उल्लेखनीय योगदान के लिए प्रथम पुरस्कार के रूप में शील्ड और प्रमाणपत्र दिया गया।

नराकास(TOLIC) के तत्वावधान में निफ्ट(NIFT), गांधीनगर द्वारा आयोजित निबंध प्रतियोगिता के लिए संस्थान की **सुश्री प्रतिभा गुप्ता**, वैज्ञानिक अधिकारी – एफ को **प्रथम पुरस्कार** के रूप में 5,000 रुपये एवं **श्रीमती शिल्पा खंडकर**, वैज्ञानिक सहायक – डी को **द्वितीय पुरस्कार** के रूप में 2,500 रुपये प्रमाण पत्र सहित प्रदान किये गये। इनके द्वारा लिखित निबंध का विषय था - **जलवायु परिवर्तन का भारतीय अर्थव्यवस्था पर असर एवं भारतीय अर्थव्यवस्था का वैश्विक विकास में योगदान।**

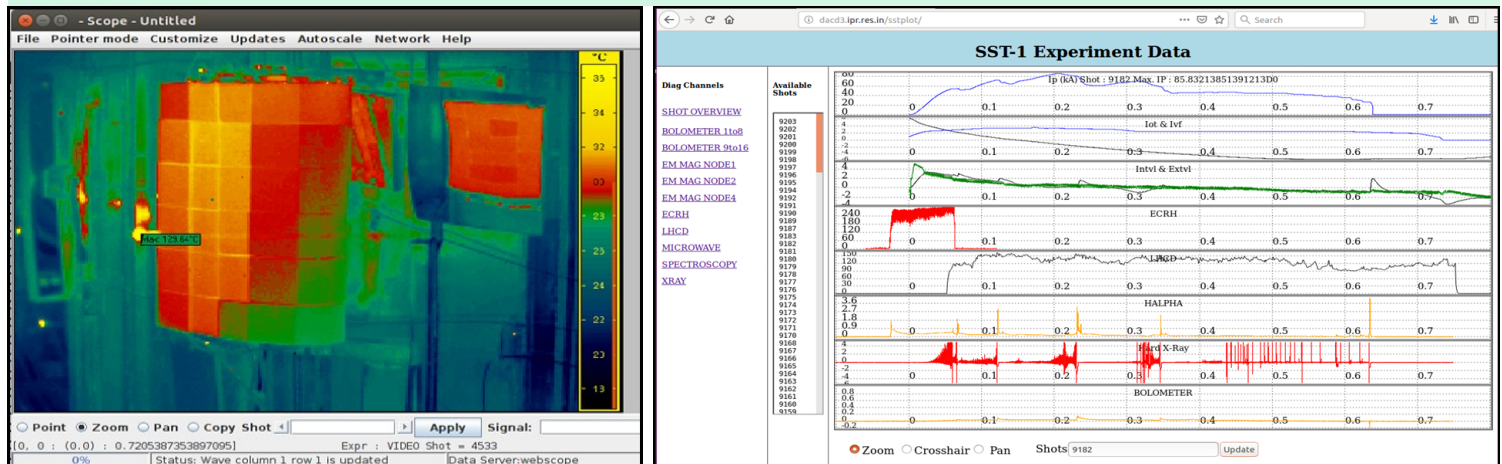
जनगणना कार्यनिदेशालय, गांधीनगर द्वारा आयोजित सामान्य ज्ञान प्रतियोगिता के लिए **श्री वृषांक मेहता**, वैज्ञानिक अधिकारी-डी को **द्वितीय पुरस्कार** के रूप में 600 रुपये एवं **श्री हिमांशु त्यागी**, वैज्ञानिक अधिकारी-डी को **प्रोत्साहन पुरस्कार** के रूप में 300 रुपये प्रमाण पत्र सहित प्रदान किये गये।



MDSplus is an open source data acquisition and analysis software library developed by MIT. It provides direct and uniform access to different data types irrespective of their format, source and location. It stores data in a hierarchical tree format that provides context for data, relationship between them and easy browsing of shot data.

To adapt MDSplus for SST-1's experimental data, MDSplus Python module along with MDSplus objects libraries are used. For continuous data acquisition, the MDSplus datafile is being stored incrementally in a linked list of data segments. An index of these data segments is maintained in such a way that retrieval of subsets of the data can be performed properly and efficiently using start, end and optionally a delta time using provided libraries.

To access the SST-1 experimental data over the web, WebScope is configured, which is based on http protocol using Asynchronous JavaScript and XML (AJAX) technology. Web based data access configuration has been implemented using available Python module via Web Server Gateway Interface (WSGI). Python interface and WSGI implementation allows the requested experimental data access inside any modern browser with JavaScript API.



(L) Video data file played from jScope (R) SST-1 Shot overview plot for shot#9182 on Web Browser using WebScope

Prevention of Liquid Nitrogen Fluid Losses of 80 K Distribution System of SST-1

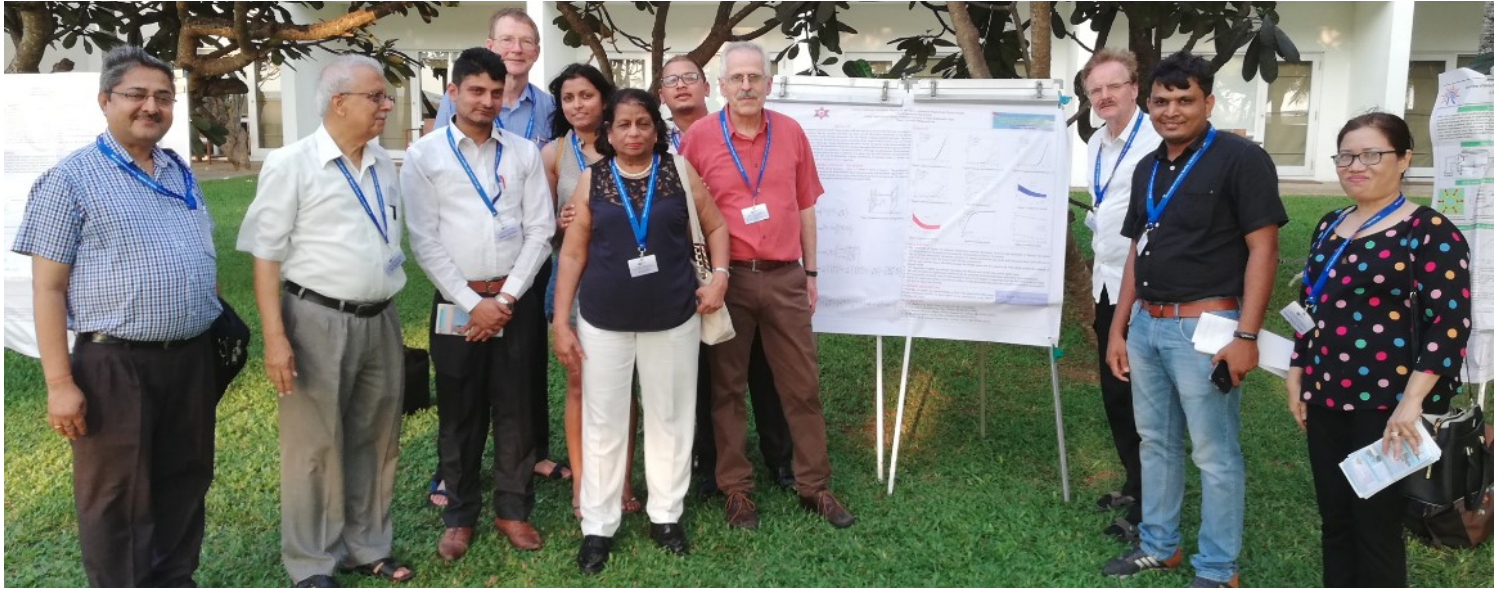
In SST-1, sub-cooled LN₂ fluid is used in various sub-systems of 80 K distribution for cooling to reduce the heat load. The LN₂ returns from all 80 K applications via the phase separator to the sub-cooler vessel by gas and liquid separation process. During past experimental campaigns of SST-1, frequent dripping of LN₂ was observed in the main vent line which was not safe for persons working there and also was having cost implications due to wastage of LN₂.

Various in-house solutions were tested out, namely, problem analysis and heat load calculation, re-routing of return cryo transfer lines to the phase separator, replacement of the phase separator supply valve, re-routing of the venturing piping and dis-assembly and re-fabrication of the inner process pipe, vacuum barrier at 80 K etc.

In the present SST-1 campaign, no LN₂ fluid was seen to be dripping out from the vent line and the fluid consumption was seen to have reduced from 1400 l/hr to 1000 L/hr, which resulted in cost saving. [Rajiv Sharma, SST-1 Cryogenic Division]



(L) Valve installation in LN₂ Phase Separator (R) Return LN₂ from 80 K Applications



Dr. Sudhir Nema gave an invited talk entitled “Non-thermal atmospheric pressure plasma technologies for societal benefits” at the 9th International Conference on Frontiers Of Plasma Physics And Technology (FPPT-9) 8-12 April 2019, Colombo area, Sri Lanka. He also chaired a session at this conference. In the same conference, **Mr. Amit Kr. Patel**, Research Scholar gave a poster presentation entitled “On the characteristics of argon plasma in a multi-pole line-cusp variable magnetic field”. He received the “Best Poster” award for this presentation.

Visit of Dr. Banerjee to IPR

Dr. Srikumar Banerjee, Chancellor, Kashmir University and past Chairman, AEC and Secretary DAE, visited IPR on 6 May, 2019. He visited the SST-1 Tokamak and interacted with the scientists.



- ◆ **Dr. P. N. Maya**, University of Greifswald, Germany, gave a talk on "Role of Fusion-Plasma Surface Interactions in Tokamaks: Recent Results and Emerging Areas" on 30th April 2019
- ◆ **Mr. Arun Pandey**, Institute for Plasma Research, Gandhinagar, gave a talk on "Development of a permanent magnet based helicon plasma source" on 1st May 2019
- ◆ **Mr. Pravin Kumar Tiwari**, Department of Physics, University of Allahabad, gave a talk on "Elemental analysis using spectral emission from laser produced plasma" on 1st May 2019
- ◆ **Mr. Abhishek Sinha**, Institute for Plasma Research, Gandhinagar, gave a talk on "Assembly of Michelson Interferometer Diagnostics with Acquisition & Signal Processing of Calibration Data" on 2nd May 2019
- ◆ **Dr. Arkaprava Das**, Inter-University Accelerator Centre, New Delhi, gave a talk on "Phase transformation studies for CdO based thin films and nano-composites" on 2nd May 2019
- ◆ **Mr. Mayank Rajput**, Institute for Plasma Research, Gandhinagar, gave a talk on "Study of transmutation, gas production and displacement damage in iron, tungsten and chromium for D-T neutron irradiation" on 3rd May 2019
- ◆ **Ms. Sneha Gupta**, Institute for Plasma Research, Gandhinagar, gave a talk on "Plasma flow equilibria in 2D cylindrically symmetric expanding magnetic field" on 7th May 2019
- ◆ **Mr. Amitkumar M. Patel**, of IPR, Gandhinagar, gave a talk on "Development of PWM Rectifier" on 9th May 2019
- ◆ **Mr. Yogesh Sharma**, Banaras Hindu University, Varanasi, gave a talk on "Studies on Dispersion Characteristics of Electromagnetic Waves in Magnetized One Dimensional Ferrite Photonic Crystals" on 10th May 2019

Upcoming Events

- ◆ 14th International Conference on Numerical Modeling of Space Plasma Flows (ASTRONUM-2019), Paris, France, 1-5 July 2019 <http://irfu.cea.fr/ASTRONUM2019/>
- ◆ 46th European Physical Society Conference on Plasma Physics (EPS2019), Milan, Italy, 8-12 July 2019 <https://www.epsplasma2019.eu/>
- ◆ International Conference on Phenomena in Ionized Gases (ICPIG 2019), Sapporo, Japan, 14-19 July 2019 <http://icpig2019.qe.eng.hokudai.ac.jp/>
- ◆ ASME Pressure Vessels & Piping Conference (PVP 2019), San Antonio, United States, 14-19 July 2019 <https://icg-eac.org/event/asme-pressure-vessels-piping-conference-pvp-2019/>
- ◆ International Conference on Research and Applications of Plasmas, Opole, Poland, 15-19 July 2019 <http://plasma2019.wmf.uni.opole.pl/>

Know Our Colleagues



Mr. Jatinkumar Patel joined IPR in 2003 as an Engineer – SD in the RF-Group. Before joining IPR, he worked in the industry for 6 years in the field of process control and industrial automation using PLC, AC drives and microcontroller based instruments design. At IPR, he was responsible for Data Acquisition and Control system application development, installation, testing and finally commissioning with the LHCD and ECRH systems in RF-Group. He was also involved in installation and commissioning of Gyrotron tubes in ECRH division, designing DAC systems using PLC, VME and PXIe hardware. Recently, PXIe based DAC system for ECRH operation has been commissioned in ECRH. He has supervised graduate and post-graduate students at IPR for their academic projects. Presently he is working as a Scientific Officer – F in the ECRH division. He is responsible for ECRH Data acquisition and control systems, its hardware selection and application software development as well as upgradation of the same as per future system requirements. His areas of interest includes artificial intelligence and machine learning applications in fusion and control systems, remote handling, IOT and drone applications.

Mr Bharatkumar Arambhadiya joined IPR in April 2003 in the Aditya Vacuum Section, where his main activities were development of Aditya Vacuum Control System, Vacuum Measurement & Control Instrumentation, Gas Feed system and the Tokamak Discharge Cleaning. During 2009-2014, he was deputed to ITER France, where, he successfully completed the Conceptual Design Review & Preliminary Design Review of Instrumentation of ICH&CD system and also was involved in the development of ICH&CD Control System Prototype. He joined Electronics & Instrumentation Division after returning back to IPR. He has developed several systems such as the Aditya-U vacuum vessel Baking Control System, Automatic High Voltage Capacitor Bank Charging System, Outgassing Measurement Control system, SST-1 Pellet Injection Control System, Aditya-U Glow Discharge Control System, Aditya-U temperature monitoring system, Aditya-U Ground Monitoring Circuit, Aditya Vacuum Vessel Control System, Precision micro volt measurement circuit, SMBI control circuit for Aditya-U. His current areas of work are System Automation using PLC/SCADA, Vacuum Control Systems, Baking & Heating Control, Electronic Circuits using FPGA and Arduino, High Voltage Pulse Circuits.



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