

The editorial committee of the IPR newsletter wishes to thank all the IPR staff members for their encouragement and support that they have given to the revived newsletter. We hope that this will continue for all the forthcoming issues of "The Fourth State". Please feel free to send any comment / suggestion to the committee at <newsletter@ipr.res.in> for improvement of the look and contents of the newsletter. Thank you.

On behalf of IPR, the Newsletter team wishes all IPR'ites a very Happy Holi ! We hope that all of you will enjoy the day and play the festival of colors responsibly.





SST-1 has achieved a significant achievement of attaining a Toroidal Field of 2.0 T at the plasma major radius with the Toroidal Field Magnets being cooled with Two Phase helium on Feb 26, 2014. This is the first and unique instance anywhere in the world to operate the Cable-in-conduit-conductor (CICC) wound Tokamak magnets in a cryo-stable mode in a functional Tokamak in two phase mode up to such fields. TF field of 2.0 T at the major radius (corresponding to nearly 3.7 T transverse field on the conductor) is so far the highest field achieved in SST-1.

SST-1 has also made another unique technological achievement in being able to operate the vapour cooled current leads of the Toroidal Field Magnets with pure cold helium vapour instead of a helium bath keeping the bottom superconducting region cooled. This unique mode of operation established a new reduced enthalpy operation and efficient operation of the current leads in SST-1 Tokamak.



In campaign-VII, on March 03, 2014, SST-1 has demonstrated plasma current in excess of 50 KA in SST-1 at a field of 0.75 T assisted with ECRH second harmonic pre-ionization with a loop voltage of 2.8 V. With such operational achievements, SST -1 has not only entered into the elite group of successful operating superconducting Tokamaks but also has opened up of an window of operation with an electric field as low as \sim 0.3 V/m commensurate with the ITER operational criterion. Now SST-1 routinely operates with a flat top of 50-70 ms at a plateau current in excess of 40 kA.



The shot data for SST-1 operating at ~51 kA during the Campaign VII showing the various diagnostics in operation.

Corrosion Studies of Structural Materials with Lead Lithium (Pb-Li)



Images of Pb-Li corrosion experimental setup. (Left) Static experiment; (Middle) Thermal Convection loop; (Right) Pump driven loop

- Liquid Metal Corrosion & Coatings Section in TBM group is involved in the corrosion studies of structural materials using Lead-Lithium Pb(17)-Li. A state-of-art experimental facility has also been setup for this purpose at IPR as is evidenced by the snaps above.
- In Indian Lead-Lithium Ceramic Breeder (LLCB) test blanket module (TBM), Pb-Li is used as coolant, neutron multiplier and tritium breeder.
- Corrosion of the blanket structural material, in Pb-Li environment is one of the major concerns for high temperature application of this liquid metal.
- To study the corrosion of candidate structural materials for TBM such as P91 and IN-RAFMS (Indian Reduced Activation Ferrous Martensitic Steel), at IPR we have set up static experiments and forced convection loop experiments such as thermal convection loop and pump driven loop.
- Experimental parameters for the corrosion experiment are as follows:

Static	Buoyancy Loop	Pump driven loop	
Sample material – IN-RAFMS.	Cold leg temperature – 450° C	Test section temperature – 500 ⁰ C	
Temperature – 550 ⁰ C	Hot leg temperature – 550° C	Flow velocity – ~10 cm/sec.	
	Flow velocity - ~10 cm/sec	Sample material - IN-RAFMS	
	Sample material - IN-RAFMS		

National Science Day at IPR

After a gap of several years, the Nation Science Day was celebrated at IPR on 28th February, 2014. As part of the celebrations, quiz and elocution competitions were conducted for students of schools in and around Ahmedabad and Gandhinagar.. Apart from these competitions, demonstrations of plasma, and general physics experiments, videos on Plasma, Fusion and Tokamak based R&D and visit to Aditya Tokamak were also arranged for the public.

More than 300 students from various schools in and around Ahmedabad/Gandhinagar visited IPR during the course of the day. More than 100 people from different walks of life also visited the institute and interacted with the scientists while trying to understand the work being carried out in the institute.

In the quiz competition, students from Maharaja Agrasen Vidyalaya, Memnagar, Shanti Asiatic School, Bopal and St. Xavier's High School, Gandhinagar won prizes. In the eloquence competition conducted in Gujarati, Hindi and English languages, the prizes were won by students from *F. D. High School*, Ahmedabad, *Adarshila School*, Gandhinagar, *APS International*, Bhat, *Diwan Ballubhai School*, Ahmedabad, *St. Xavier High School*, Gandhinagar and *Shanti Asiatic School*, Bopal.



Institute for Plasma Research

National Science Day - 2014





Dr. Prabal Chattopadhyay enlightening the students on how to get a feel of measurement of physical quantities in day-to-day life.



Demonstration of basic physics concepts by Dr. N. Ramasubramanian



Students arriving at the Institute for NSD celebrations.

High Performance Computing Facility @ IPR

IPR has recently acquired a state-of-the-art High Performance Computing system (HPC cluster) and it has been made operational since the middle of February 2014. This **5.5 Terra Flop** CPU based HPC cluster from IBM is capable of performing more than 5 trillion (10¹²) floating-point operations per second. This 320 core HPC Cluster has been named "**Udbhav**".

The system comprises of 10 numbers of $x86_64$ bit IBM x3750 M4 servers, an 18 port QDR Infiniband switch for high speed interconnect (40Gbps) and a 26 port GigE Switch for the hardware management and OS provisioning. One server has been configured as Head node and the remaining 9 as the compute nodes. The HPC system is also equipped with 4 QDR and 4 x 8 GB FC ports for storage and high speed connectivity. The HPC system is connected through 10KVA UPS.

Ope	rating System	SLES with SP3
Clus	Cluster Management Toolkit IBM Platform Cluster Toolkit 4.1.1.1	
Com	pliers and Libraries	Intel Cluster Studio XE 14.x
MPI		OpenMPI, IntelMPI, MPICH2
Back	kup Software	IBM Tivoli Storage Manager
	Manage Node 1 x H	ead Node 9 x Compute Nodes
k Switch		
ient Networ		Infiniband Switch
ster Managem	Tape Loader	Storage Node
Clu		Storage



"Udbhav" HPC system

Schematic of the HPC system

For more details please contact <hpcteam@ipr.res.in >

Plasma Assisted Aluminizing Treatment of Ni Based Super Alloys

Ni based superalloys such as Inconel 718 are structural materials for gas turbines and nuclear reactors. Gas turbines operate at high temperatures by which corrosion and oxidation resistance gets affected. Aluminides such as NiAI and FeAI are desired phases stable at high temperatures and also resistant to corrosion and oxidation processes.



FCIPT has developed aluminizing techniques such as magnetron sputter aluminizing and hot dip aluminizing techniques by which NiAl phases can be generated on the surface of In718 superalloys. Specifically, plasma as a heat treatment tool has been found to improve case depth of diffused aluminized layer. The project has been funded by BRNS, DAE,

High temperature plasma assisted aluminizing system and the cross-section micrograph of NiAl coating on Inconel 718 superalloy using plasma assisted heat treatment

Key features:

- Accelerated diffusion of Al in species
- Compositional homogeneity of coating
- Larger case depths compared to thermal processing
- Eco-friendly processing

The aluminide coatings have uses in the following applications:

- Bond coats in gas turbine blades
- Steam generator modules of nuclear fission reactors
- FeAl coating in blanket applications of fusion reactors
- High temperature oxidation resistant coatings for boilers and power plants

The Nectar Fountain !



March : the month of Holi. It is also that time of the year for the trees to flower, bear fruits and seeds before the monsoons sets in. The coral tree (Flame tree, Pangara) near the IPR library building has bright red flowers which attracts a lot of birds and bats to it for the sweet nectar in those flowers. With large quantities of nectar available, the birds, squirrels, and even the monkeys compete with each other for this tasty fluid. The proverbial early bird indeed does get the worm !!! Occasionally, these birds and animals also enjoy the heady high that they get from consuming the nectar that ferments overnight in the flowers. There is no prohibition in Gujarat for these birds and animals !!!! *Photographs by K. K. Mohandas*

CONGRATULATIONS



Dr. Ravi B. Grover, head of the Indian delegation to the ITER Council, was honored by the Government of India on the occasion of Republic Day (26 January 2014) with the fourth-highest civilian award, the **Padma Shri**.

Dr. Grover is the principal adviser of the Department of Atomic Energy in India, a member of the Atomic Energy Commission, and Director of the Homi Bhabha National Institute (HBNI).

He played a pivotal role during negotiations with various governments and the IAEA towards opening international civil nuclear trade between India and other countries. He also conceptualized and set up the HBNI as a university-level institution. He was also part of the team that played a key role in the negotiations leading up to India joining the ITER Project as a full partner in 2005.



Mrs. Chhaya K Chavda joined IPR in 1985 and was involved in the design, development and commissioning of electronics for various experimental systems and basic plasma experiments . She currently works for Aditya operation."





Mr. Chandresh J. Hansalia joined IPR in 1986 and was involved in the design, development and commissioning of electronics for the Aditya and SST-1 diagnostics and SC-Magnets quench. He currently works



Mr Mohandas joined in 1986 and was associated with the BETA System and Lab and various basic plasma experiments. Later he moved on to Free Electron Laser Experiment and is currently with the accelerator division.

Final Design Review for ITER Cooling Water Systems (Lot-1 Piping) held at ITER-India⁶

The Final Design Review (FDR) for the first lot of piping of ITER Cooling Water Systems was held at ITER-India on 7th March 2014, with participants from ITER-India, ITER Organization (France) and the contractor (L&T). The design review panel consisted of experts from NPCIL, ITER Organization & IPR, and they appreciated the hard work done by ITER-India Cooling Water System group and L&T. It is expected that the first lot of piping will be delivered to the ITER site in France during September-October 2014. By this year end, final design reviews for the remaining lots of piping and equipment will be carried out in a phased manner.



Promoting Fusion to the Public at National Science Carnival, Gujarat Science City

On the invitation of Gujarat Council of Science City, IPR participated in the National Science Carnival, a public exhibition held during 28 February to 6 March 2014 at Science City, Ahmedabad. Members from ITER-India and IPR took out time from their busy schedule and actively participated in this event by interacting with the school & college students and general public, spreading a basic awareness on fusion technology and promoting the work on fusion going on at IPR and ITER. The stall displayed various posters related to activities of IPR and ITER-India, played technical videos and also distributed leaflets/brochures to the visitors to the stall.



The IPR booth at the National Science Carnival which was organized at the Science City, Ahmedabad

IPR staff interacting with the students at the National Science Carnival.

"Every kid starts out as a natural-born scientist, and then we beat it out of them. A few trickle through the system with their wonder and enthusiasm for science intact" — Carl Sagan

IPR STAFF CLUB

Volleyball Tournament 2013-14: IPR youth participated in huge numbers for the Volleyball and Badminton Tournament 2013-14. Starting from March 3, 2014 the matches have been very exciting and are expected

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Participating Teams		con-
Group A	Group B	clude
TTP United	Lion Scholars	till Mid
TTP2k2	Shaolin Scholars	
Green Scholars	ITER-India	
Admin Tigers		

<u>Semi Final Clashes</u>

March.

TTP United v/s Shaolin Scholars



Volleyball tournament in progress at IPR

Participating Teams for Badminton (Doubles)				Semifinal Lineup (Doubles)	
Group-A	Group-B	Group-C	Group-D	Vinit /Shivakant v/s Pratik /Siddhartha Mukesh / Ketan v/s Kshitish /Aditya <u>Semifinal Lineup (Singles)</u> Ashwin v/s Shivakant Vivek v/s (Siddhartha v/s Pratik)	
Vinit/ Shivakant	Ashwin/Atul	Vivek/Sagar	Kshitish/Aditya		
Sajal/Suraj	Avik/Deepak	Vrushank/ Deepak	Nayan/ Vishvarishi		
Rayjada/ H.K.Sharma	Pratik/ Siddhar- tha	Mukesh/Ketan	G.Ravi/Akshay		

SAC Cricket Tournament – 2014

DR.VIKRAM SARABHAI SPACE CUP-2014 started on 8th Feb 2014, where 2 teams from IPR participated as IPR-I and IPR -II team. IPR-I qualified for the semi-finals and also entered the Finals. Final Match of the SAC Cricket Tournament was played on 9th March, 2014 between IPR-I V/s SAC at SAC Ground. IPR–I Best performers at FINALS

Highlights of the FINAL MATCH :

- SAC won the toss and chose to field first.
- IPR-I scored 126 run in 25 overs loosing 6 wickets.
- SAC scored 127 runs at the loss of 2 wickets in 21.1 over.
- SAC won the Final Match with 8 Wickets.

During the tournament League matches, three IPR-1 team players



IPR-I Team: Nilesh Contractor (C & Wk), Joydeep Ghosh (VC), Gaurav Bhatt, Satish Tailor, Nayan kumar Shukla, Vishwarishi maurya, Nitin Bairagi, Deepak Yadav, Rakesh Tanna, Nitin katara, Mahesh Ghate, Vara Prasad, Piyush Raj, Roopendra Singh Rajawat, Mayur Mehta, Hamang Agravt with Suptapa Ranjan (President, IPR Staff Club)

IPR–I Best performers at FINALS			
Batsman	Deepak Yadav 30 runs		
Bowler	Joydeep Ghosh 2 wickets		

IPR-I Best Performers of the TOURNAMENT

Leading BatsmanLeading BowlerVara Prasad, 156 runsVishwarishi Maurya, 10 wkts



Nilesh Contractor, Captain IPR-I receiving the Runners-up Trophy

National Safety Week at IPR

The 43rd National Safety Week was celebrated at IPR from 4-10 March, 2014. As a campaign of the celebration, the institute organized various competitions to create safety awareness among its employees. Competitions on (a) *Slogan* in English & Hindi languages, (b) *Poster*, (c) *Quiz and (d) Essay* based on theme "Managing Stress at Workplace and Control Hazards" for the employees at IPR, FCIPT, ITER-Inda. Overwhelming response was received from the employees for various competitions.

Apart from these competitions, following activities were organized during the week:

- Awareness Program for Contractor Drivers on "Defensive Driving".
- Demonstration of Water Mist type Fire Extinguisher for the employees. This type of fire extinguisher is very much useful for all classes of fire.
- Demonstration of Automated External Defibrillator (AED) for employees. This machine may be useful for sudden cardiac
 arrest or electric shock till the victim is shifted to a hospital or ambulance arrives.
- Demonstration of Personal Protective Decontamination Unit (PPDU) for employees. This unit may be used during radiation exposure.
- Demonstration of Fire Hydrant System installed at ITER-India laboratory building for the security agencies.

Short video films on Safe Driving for 2 & 4 wheelers, Defensive Driving Tactics, Chemical Safety, Electrical safety at the workplace, Safe Handling of Compressed Gas Cylinder, Good Housekeeping, Commitment to Safety etc. were screened.

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Images from various events organized during the Safety Week



Demonstration of use of the fire hydrant system during the safety week Prof. Dhiraj Bora visiting the safety exhibition In the various competitions / events organized by the Safety Committee, the following IPR staff won prizes. Our hearty congratulations to all of them.

Event	1 st Prize	2 nd Prize	3 rd Prize
Safety Poster	Mr. Anuj Garg	Ms. Unnati Patel	Mr. Rajamannar Swamy
Safety Essay	Ms. Vidhi Goyal	Mr. Sunil Misal	Mr. Avik Bhattacharya
Safety Quiz	Mr. Prakash Parmar	Mr. Chirag Bhavsar	Mr. Pramod Parmar
Hindi Safety Slogan	Mr. L.N.Gupta	Mr. Mitesh Patel	Ms. Pratibha Gupta
English Safety Slogan	Mr. Rajiv Sharma	Mr. Raj Singh	Mr. Amaliar Rajnikant

Past Events @ IPR

- Prof. James Bradley, Electrical and Electronics Engineering Department, University of Liverpool, gave a talk on "The detection and influence of negative ions in reactive magnetron sputtering" on 12th February 2014
- Mr. Raj Singh, Institute for Plasma Research, Gandhinagar, gave a talk on "Minimization of Error in Voltage Probe Data to find Antenna-Plasma Coupling Impedance for ICR Heating" on 19th February 2014
- Dr. Richard Pitts, ITER Organization, gave a talk on "Physics Basis and Design of the ITER full-W Divertor" on 6th March 2014
- Dr. Edward Thomas, Physics Department, Auburn University, gave a talk on "Controlling complexity: studies of waves and instabilities in magnetized plasmas and magnetized dusty plasmas" (Colloquium #230) on 11th March 2014
- Mr. Huw Leggate, National Centre for plasma science and Technology, Ireland, gave a talk on "An Indo-Irish collaboration in fusion - The Institute for Plasma Research and Dublin City University" on 14th March 2014

Upcoming Events

- Forty-First IOP Plasma Physics Conference, London, United Kingdom, 14 17 April 2014 http://plasma14.iopconfs.org/home
- First International Plasma Technologies Congress, Kayseri, Turkey, 28 30 April 2014 http://plasmacongress.org/
- SERB School on "High Power Laser Plasma Interaction", Indian Institute of Technology Delhi, New Delhi, 5-23 May 2014. http://www.iitd.ac.in/sites/default/files/cws_event/SERC.pdf

बधाइयाँ

परमाणु ऊर्जा विभाग वर्ष 2012-13 के लिए राजभाषा गृह पत्रिका के पुरस्कार हेतु चयन समिति ने श्रेष्ठ राजभाषा गृह पत्रिका पुरस्कार (सहायता प्राप्त संस्थानों के लिए) की वर्ष 2012-13 की ट्रॉफी के लिए प्लाज़्मा अनुसंधान संस्थान, गांधीनगर की राजभाषा गृह पत्रिका "प्लाज़्मा ज्योति" का (टाटा स्मारक केंद्र, मुंबई की राजभाषा गृह पत्रिका "स्पंदन" के साथ संयुक्त रुप से) चयन किया है । उपरोक्त ट्रॉफी दिनांक 16 जनवरी, 2014 को गणित विज्ञान संस्थान, चेन्नई में आयोजित किए गए परमाणु ऊर्जा विभाग के अखिल भारतीय राजभाषा सम्मेलन के उद्घाटन समरोह में मुख्य अतिथि के करकमलों द्वारा संस्थान को दी गई । इस पत्रिका के संपादक दल मण्डल के सदस्य श्री प्रवीण कुमार आत्रेय जी, श्री राज सिंह जी, डॉ सूर्यकांत गुप्ता, सुश्री प्रतिभा गुप्ता एवं श्रीमति संध्या.पी. दवे को इस सफलता पर हार्दिक बधाइयाँ ।

चित्र – संस्थान की राजभाषा गृह पत्रिका "प्लाज़्मा ज्योति" को लगातार दूसरे वर्ष 2012–13 के लिए दी गई सर्वश्रेष्ठ राजभाषा गृह पत्रिका की ट्रॉफी ।



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