Year 2013
Issue 4
November

The Fourth State

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

From the editorial desk

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 / feedback to the committee at <newsletter@ipr.res.in> for improvement of the look and contents of the newsletter. Thank you..

SST-1 News

In the recently concluded SST-1 campaign, SST-1 Toroidal Field Magnet System attended 1.8 Tesla at SST-1 major radius of 1.1m in two phase flow condition. The next SST-1 campaign has begun since 13 Nov 2013 targeting the plasma current in excess of 50KA for 750ms.

!!! IPR Annual Night !!!

Ms. Sutapa Ranjan welcoming the Director.

With huge excitement, IPR Annual Day was celebrated on 19th October, 2013. The theme for this annual function was FUSION – synergy. Various colorful events were organized by the Staff Club Team. This FUSION based program included colorful performances of duet songs, dances and from people of all ages. Some of the seniormost IPR employees were also honored by the Director, IPR on this occasion.

Krishnapriya and Chhaya

Honoring some of the senior staff of IPR

Children of IPR employees were also awarded for outstanding performances in academics.

The OSMY award for the year 2013 was awarded to Mr. Ketankumar Patel (SST-1 Cryogenics).

This was followed by a verity of entertainment programs by IPR staff members and their family members. A musical program and "Garba" was also another highlight of the night !

.....Continued on P.6 and P.8

Development of Electrical Insulation Breaks for SC Magnet Devices at IPR

Electrical insulation breaks for cryogenic fluids liquid helium as well as nitrogen is a very crucial component of superconducting magnet fusion machines, main function of such insulation break is to supply Liquid helium/Supercritical helium to superconducting coils and to isolate the magnet electrically from ground potential when quench occurs in such magnets. This was developed with an industry R&D collaborator (M/s Uniglass Limited, Bangalore) with funds from BRFST.

Electrical insulation breaks

Fabrication by filament winding

Test in tensile load condition

Salient features of Developed Electrical Insulation Breaks

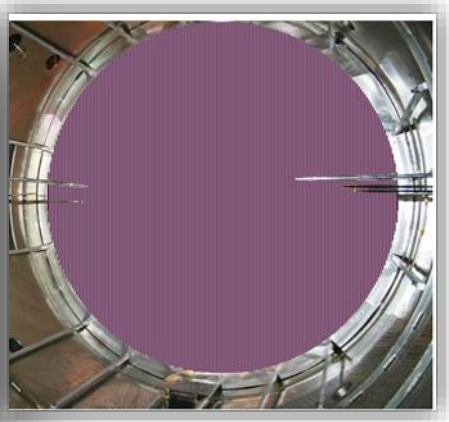
- Electrical insulation breaks has been developed using three kind of cryogenic compatible epoxies including Indian and radiation resistant high mechanical strength of ~7500 MPa S-glass fiber filaments.
- Helium leak rate achieved better than <1.0x10-8 mbar l/s at 300 K, 77 K temperature, @ 25 bar helium pressure in all options of fabricated insulation breaks.
- Electrical isolation compatible with 0-12 kV test voltage at 300 K, 77 K
- Electrical insulation break load withstand capacity in tensile condition: 6523 N as per ASTM D 638-1991.
- Huntsman resin system has shown best performance out of all variants therefore in future this option can be adopted for manufacturing the electrical insulation breaks as per the requirements.
- The In-house indigenous developed electrical insulation breaks can be used for future indigenous superconducting magnet fusion machines, electrical isolation and for low temperature experiments purpose with very much cost effective compared (10-15 times less) to outside Industries as well as Institutions.

An Overview: Large Volume Plasma Device [Part-I]

The Large Volume Plasma Device (LVPD), though a decade old facility, but still continues to contribute actively to studies of basic and fusion plasmas. A significant contribution - unambiguous excitation of Electron Gradient Turbulence (ETG), a major source of plasma loss in fusion plasma devices. With the largest Electron Energy Filter (EEF) in a laboratory plasma device to scavenge energetic electrons, controlled studies on energy and particle transport because of ETGs are being carried out.

Contact person : L. M. Awasti

The LVPD Device



Electron energy filter in LVPD

Δt_{pulse}~ 9.2 ms
Beta ~ 0.6
$V_{discharge}$ = 70 V
$I_{discharge}$ » 200 A
n_e ~ $2x10^{11}cm^{-3}$
T_e ~ 3eV

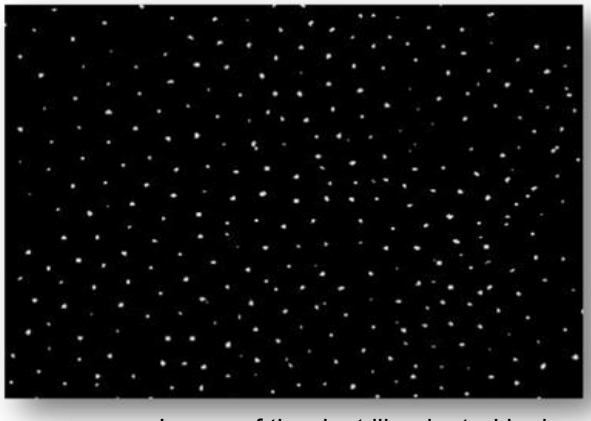
Double Walled, SS304
Water Cooled
Diameter– 2 meter
Length - 3 meter

Data Acquisition System [1GS/S, 16 Channels, 30k record length]
Automated 3-Axis probe drive
Automated linear HV compatible probe drive (~ 1m travel length)

No. of filaments	36
Filament power supply	1500 A , 60 V
Magnet coil system	B_{Axial} ≤150G
Discharge Power system	4kA, 120V, Δt=5-15ms, $t_{turnoff}$ ~ 20ms
Pressure	4 x 10^{-4} Torr,

Experiments on Non-Linear Waves in Complex (Dusty) Plasmas

- Dusty plasmas (complex plasmas) are low-temperature multi-species ionized gases including electrons, ions, and negatively (or positively) charged dust grains typically micrometer or sub micrometer size.
- In contrast to normal two component plasma, the dusty plasma system can be either weakly or strong correlated depending on the strength of the Coulomb coupling parameter which is defined as the ratio of electrostatic energy to the thermal energy of these charge dust particles.



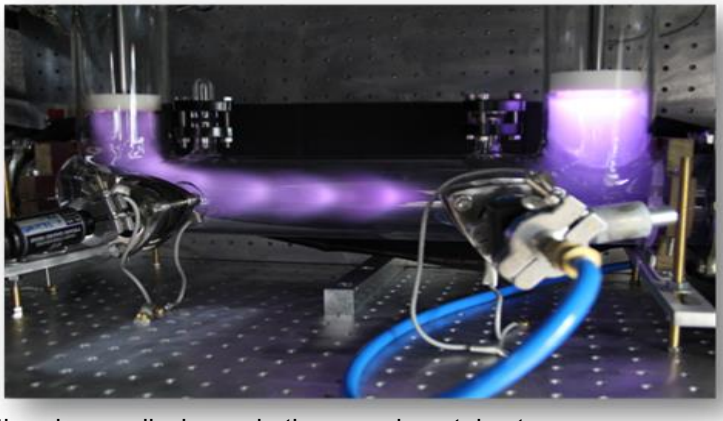


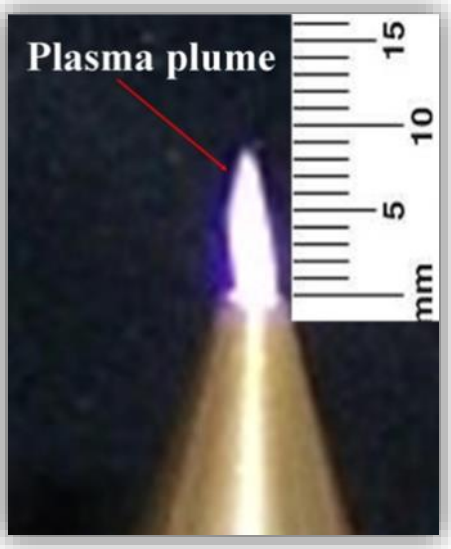
Image of the dust illuminated by laser and the plasma discharge in the experimental setup.

- Due to the high charge capacity, the dusty plasma provides an excellent medium which supports to study the phase transition (solid to liquid to gas) like water, linear and nonlinear waves, macroscopic and microscopic structures etc.
- A simple U-shaped glass tube has been assembled at IPR to study the interactions of multiple linear (Dust Acoustic Waves, Transverse Shear Waves, Dust Ion Acoustic Waves) and nonlinear waves/structures (Dust-Dust Acoustic Solitary Waves, Dust Ion Acoustic Solitary waves, Mach Cone) in a complex plasma.

- **Studies:** Interactions between multiple Dust Acoustic Solitary waves, wake structures and Mach Cones
- **Diagnostics:** Optical diagnostics is enough to record the dynamics of the dust particles
- **Contacts:** Pintu Bandyopadhyay and Surabhi Jaiswal.

Non-Thermal Atmospheric Pressure Plasma Jet For Bio-Medical Applications

- Atmospheric pressure plasma jets (APPJ) offer a unique environment in plasma medicine, allowing treatment of soft materials, including biomaterials such as living tissues.
- The mechanism underlying this non-thermal discharge, however, remains unsettled that it has been often taken as resulting from dielectric barrier discharge or vaguely referred as streamer like.
- In this case, the plasma jet of Argon (or compressed air) is formed between two metal electrodes at mid frequency range (50 to 150 kHz). The high electron temperature enhances the plasma chemistry processes while the plasma gas remains close to room temperature.



Advantages & applications of APPJ:

- Alters the surface properties without affecting their bulk property.
- The temperature varies from 30 ^{0}C to 70 ^{0}C.
- It is eco friendly and no vacuum/water is needed for the process.
- It has high blood coagulation efficiency.
- Plasma jet could be adapted to eat away at the cancer cells a few layers at a time without damaging the surrounding tissue with more precision as compared to surgical blades.
- It can be most useful by military, paramilitary and police forces in areas where it is difficult to transport bulky medical equipment to.
- APPJ can help to coagulate the blood very short time span with its more efficient process, which can be a boon in the battlefront areas or during natural calamities.
- It can be efficiently used for plasma sterilization, skin diseases treatment, bacteria de-activation, skin cancer therapy etc.

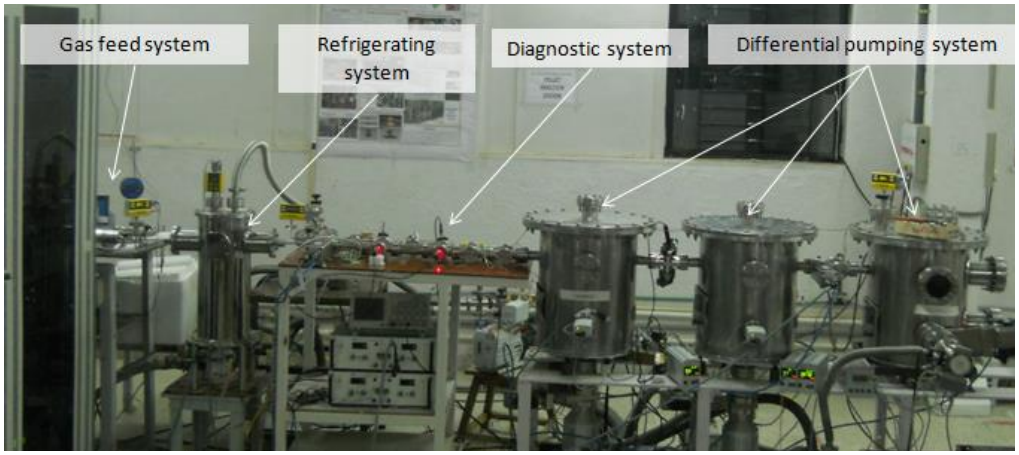
!! Congratulations !!

Ketankumar Patel was awarded with **"OSMY Award" for the year 2013** at *IPR Annual Night* on October 19, 2013. Prof. Dhiraj Bora, Director IPR presented the award to Ketankumar Patel appreciating his distinguished contribution towards SST-1 Cryogenic operations. Working for SST-1 Cryogenic Division for last 4 years, he has been largely involved in Alignment of Helium compressors, round the clock operation of Helium plant, cryogenics transfer lines (helium as well as nitrogen), installation, commissioning and general maintenance activity of cryogenics plant.

Cryopump and Pellet Injector Development

The **S**ingle barrel **P**ellet **IN**jection **S**ystem (**SPINS**), which was indigenously developed at IPR is now producing pellets of the following parameters ;

- Size : 4 mm cylindrical shape of equal dimension
- Speed: 600 – 950 m/s depending on propellant condition



Single **P**ellet **IN**jector **S**ystem (SPINS) with various subsystems

Lightgate signal confirming pellet intactness

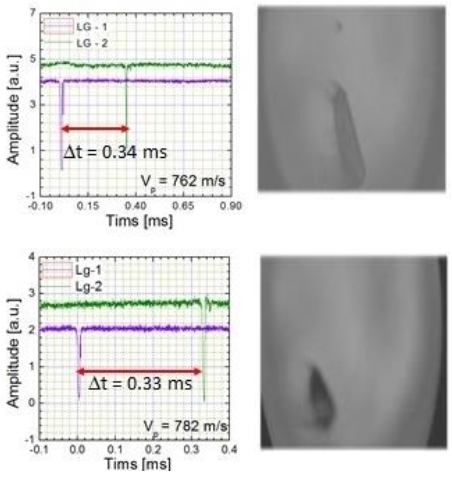


Image of pellets being ejected

Maximum intact pellets were found to be in the speed range of 750-850 m/s. Further plans to reduce pellet size and increase speed of the pellets as per the requirements of Aditya and SST-1.

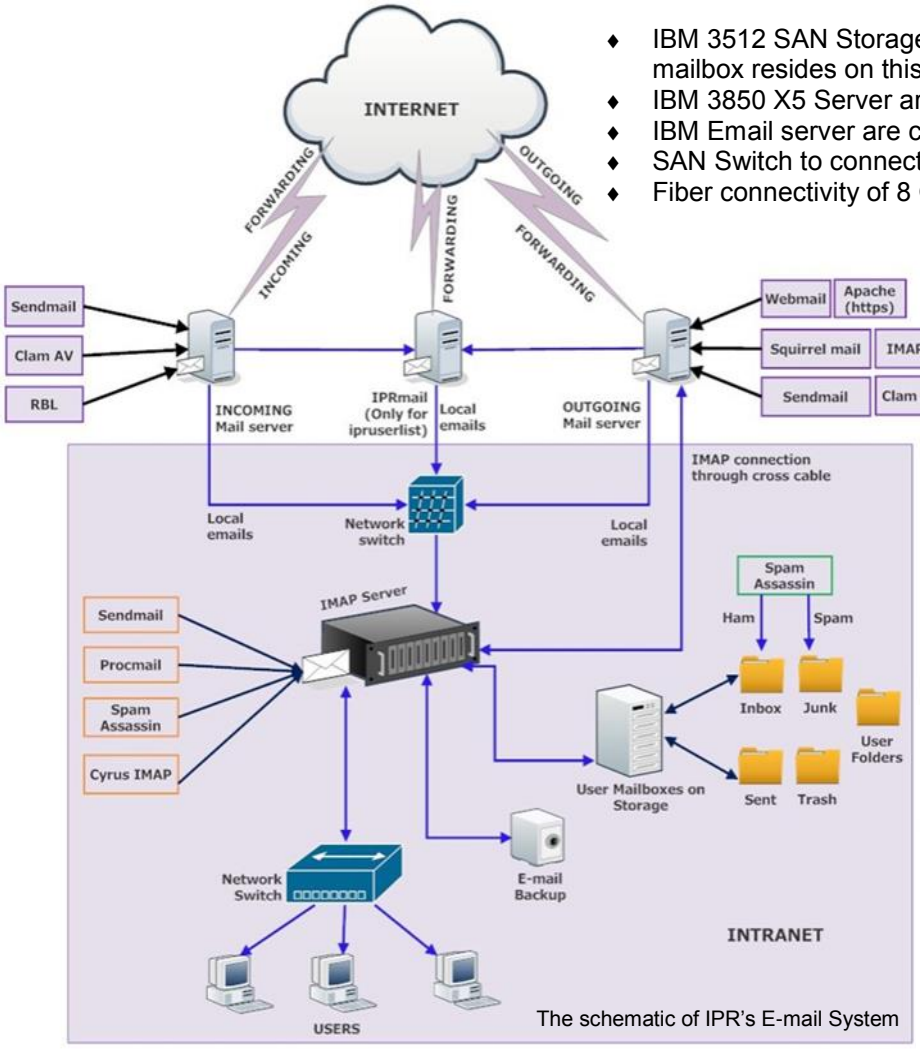
IPR's E-mail Scheme

Hardware

- IBM 3512 SAN Storage is used as a storage for user emails. All user mailbox resides on this storage. Capacity of storage is 10 TB.
- IBM 3850 X5 Server are being used as email servers.
- IBM Email server are connected to storage with SAN Connectivity.
- SAN Switch to connect to IBM storage and IBM servers.
- Fiber connectivity of 8 GBPS between IBM storage and IBM servers.

Software

- Sendmail is using as MTA (Mail Transfer Agent).
- spamcop.net and spamhaus.org as RBL (Realtime Blackhole Lists)
- ClamAV Anitvirus Software is used for virus filtering.
- SpamAssassin software is used for SPAM filtering.
- Procmail.
- Cyrus IMAP server as IMAP server.
- SquirrelMail as Webmail Client.
- Apache Webserver.



The schematic of IPR's E-mail System

Incoming mail profile for September 2013

Total mails : 176998

For any issues related to IPR email service, please send an email to <cc@ipr.res.in>

Science without religion is lame, religion without science is blind — Albert Einstein

BUTI Foundation Awards

The Buti Foundation Awards were founded by Prof. Bimla Buti, who retired as Professor of Astrophysics from Physical Research Laboratory, Ahmedabad. The **Buti Young Scientist Award was** instituted in 2004 to encourage young scientists (below age of 35yrs) working in the area of Plasma Science & Technology. The two awards consists of a Certificate of Merit and a cash prize of Rs.10,000 each. One award is exclusively for scientists from Universities and Colleges and the second award is open to all young scientists.

On behalf of Buti Foundation, this award is presented by the *Plasma Science Society of India (PSSI)* at its Annual National Conference to the selected young researchers for the best presentation in the Buti Young Scientist Award session at the National Symposium on Plasma Science & Technology. This award has been won by several IPR research scholars in the past *viz;* **Sambaran Pahari** (2004), **Suraj Sinha** (2005), **Pintu Bandhyopadhyay** (2006), **Maya P.** (2007) and **Sharad Kumar Yadav** (2009).

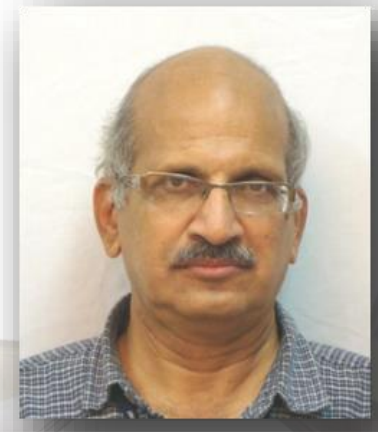
The Buti Foundation Award for excellence in Plasma Science and Technology was instituted in the year 2007. This award consists of a citation, a gold medal and a cash prize of Rs.50000. On behalf of Buti Foundation, Physical Research Laboratory, Ahmedabad administers this award. From IPR, Dr. Subroto Mukherjee was honored with this award in the year 2007 and Dr. Subrata Pradhan in the year 2013 (along with Dr. Prasad Subramanian of IISER, Pune).

Dr. S. Pradhan receiving the Buti Award from Dr. U R Rao at PRL on 12th Nov, 2013

Dr. S. Mukherjee receiving the Buti Award from Prof. Bimla Buti in October, 2007

Silver Stars of IPR

Professor. Dhiraj Bora joined IPR in 1982 and since then he has been heading different groups at IPR and was also the DDG at ITER, France. He is currently the Director of IPR



Mr. Shailesh B. Bhatt, having joined IPR in 1973, he has been largely involved in vacuum science and technology for the past 39 years and is presently associated with the vacuum system of Aditya .

Mrs. Monika Fernandes, associated with IPR since 1982, she has been with the combined Purchase and Stores department earlier and now with the purchase department of the Institute.

Diagnostics in Aditya Tokamak

Tokamak Plasma diagnostics are a pool of methods, instruments and experimental techniques, developed/borrowed from different streams of Physics, used to measure different properties of tokamak plasma, such as plasma density, temperature, radiations, their spatial profiles and dynamics etc. They enable us to know about the plasma we produce in tokamaks and are also used for controlling the plasma.

Mirnov Probe	Magnetic fluctuation & MHD instability	**Position Probe**	Vertical / Horizontal plasma position & Plasma equilibrium
H-α Monitor	Edge recycling measurement	**Thomson Scattering**	Core temperature and density
Diamagnetic Probe	Plasma stored energy	**ECE**	Plasma electron temperature
Charge Exchange	core ion temperature	**Impurity Line Monitoring**	Impurity (Oxygen, Carbon etc) content measurement
IR Thermography	power losses through radiation & limiter thermography	**Mach Probe**	Plasma rotation
IR Camera	Limiter Temperature	**Bolometer Array**	radiation power loss & emissivity distribution measurement
Soft X-ray Array	Saw tooth oscillation and MHD activity measurement	**Single Langmuir Probe**	Edge parameters like density, temperature, floating point and fluctuation measurement
Single Channel Bolometer	Total radiated Power measurement	**Microwave Interferometry**	Chord Average Electron Density
Soft X-ray:	Electron temperature measurement	**Hard X-ray**	High energy photon measurement
Rogowski Coils:	Used to measure the current flowing through the inner surface of the torus	**Survey Spectroscopy**	Identification of impurities
VUV Spectroscopy	Impurity estimation, ion temperature	**NIM Spectroscopy**	Identification of impurities
Rogowski coil	Plasma Current	**Loop Voltage Coil**	Loop voltage
H- α Array	Profile of Hα emission		

Upcoming Events

- Topical Conference on Atomic Processes in Plasmas (ISAMP-TC-2013), 18-20 November 2013, for more details visit: http://www.ipr.res.in/TC2013/
- A School on Advanced Characterization methods for Nanophase Materials (ACNM-2013), 22-24 November, 2013, for more details visit http://www.plasmaindia.com/subsite/index.htm
- Workshop on Nanoscale Excitations in Emergent Materials (NEEM 2013), 25-26 November 2013, for more details visit: http://www.plasmaindia.com/neem2013.html
- 28th National Symposium on Plasma Science & Technology (Plasma 2013), 3-6 December 2013, at KIIT University, Bhubaneswar - 751024, Odisha, for more details visit: http://www.kiit.ac.in/plasma2013/

IPR Annual Night

Dance performance by children of IPR staff

Duet by Anitha and Atrey

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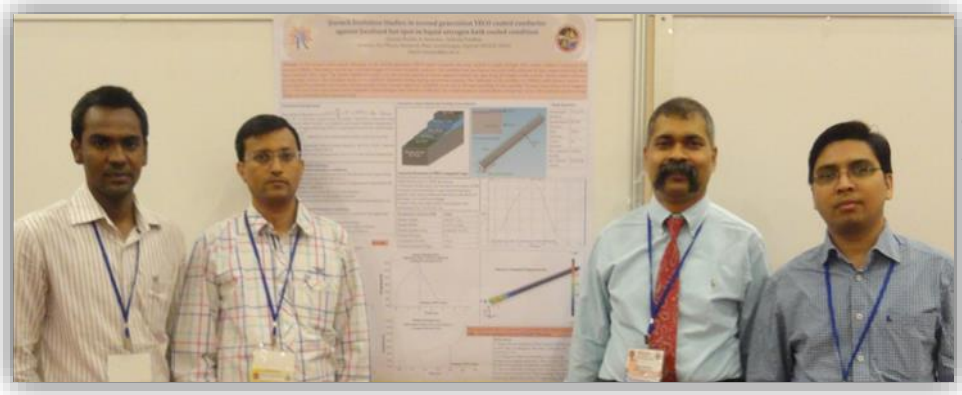
IPR Participation in International Events

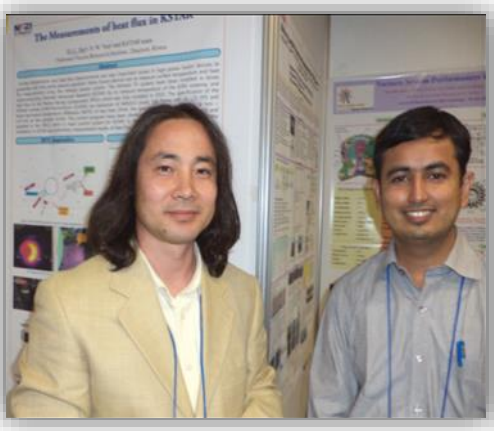


7th ACASC: The 7th Asian Conference on Applied Superconductivity and Cryogenics was held on 23-25October,2013 at Cappadocia, Turkey.

IPR representatives at this meeting were ; Dr. Subrata Pradhan, Mahesh Ghate and Piyush Raj from Magnet Development Technology Division and Dashrath Sonara from SST- 1 Cryogenics Division.

APFA 2013: 9th General Scientific Assembly of the Asia Plasma and Fusion Association was held on 5th - 8th November 2013 at Gyeongju City, Korea.

In this Asian conference, IPR was represented by Santosh P. Panya (IR Thermography), Vipul Tanna (SST-1 Cryogenics), Ashoo. N. Sharma (SST-1 Magnets), Ziauddin Khan (SST-1 Vacuum), Aveg Kumar (SST-1 Operation and Control), , Prashant Singh (W.C and A.C section), Gourab Bansal (NI-NB Division) and Kalpesh Dhanani (SST-1 Vacuum), Dr. Subrata Pradhan and Prof. Dhiraj Bora who presented a talk on "*Indian Fusion Program including ITER-India activities*"



ICFRM16 Beijing 2013 — 16th International Conference On Fusion Reactor Materials — October 20-26,2013 — Beijing, China

ICFRM-16: The International Conference on Fusion Reactor Materials is the major international forum for information exchange about materials to be used in future fusion power systems. 16th International conference on Fusion Reactor Materials was organized on October 20-26, 2013 at Bejing, China**.** IPR was represented by Shiju Sam of the TBM Division.

Past Events @ IPR

- **Mr. Sushil Kumar Singh**, IPR, gave a talk on "*Observation and Theory of Electron Temperature Gradient Turbulence in Laboratory Plasma*" on 08th October 2013
- **Prof. Siraj Hasan**, Ex-Director, Indian Institute of Astrophysics, Bangalore, gave a talk on "*A New Window to the Sun: The National Large Solar Telescope*" (Colloquium #224) on 9th October 2013
- **Prof. S.V.S. Murty**, Coordinator, PLANEX, Physical Research Laboratory, Ahmedabad, gave a talk on "*Mars Orbiter Mission*" (Colloquium #225) on 21st October 2013
- **Prof. V . Krishan**, Indian Institute of Astrophysics, Bangalore, gave a talk on "*Magnetorotational Instability In Accretion Disks*" (Colloquium #226) on 28th October 2013
- **Mr. Sanat Kumar Tiwari**, IPR, gave a talk on "*Generalized Hydrodynamic Description of Dusty Plasmas*" on 29th October 2013
- **Mr. Gurudatt Gaur**, IPR, gave a talk on "*Study of Shear Driven Electron Magnetohydrodynamic (EMHD) Instabilities in Plasmas*" on 29th October 2013
- **Prof. Bimla Buti** of Buti Foundation gave a talk on "*Stellar Evolution from White Dwarfs to Black Holes" on 13th November, 2013.*

Prof. Buti delivering her talk at IPR.

Persistent questioning and inquisitiveness are the first requisite for any kind of learning— M.K. Gandhi

IPR Annual Night

Duet by Sutapa and Pinakin

Jamming by IPR staff (Vinay, Kedar and Pinakin)

Dancing away to the mesmerizing beats of the Garba music

From the Archives

This is how the IPR water body looked before it was remodeled in 2006. Originally designed as a fountain and cooling system for the air-conditioning, It was indeed a beautiful sight to see all the fountains in full flow, specially at night. The fountain system was remodeled to the current one after the air-conditioning system was changed, which made the old fountain redundant.

The Team

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Swati Roy

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Ramasubramanian N.
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