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Issue 09

September 2016

The Fourth State

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

70th Independence Day Celebrations at IPR and CPP-IPR

The 70th Independence Day was celebrated with a lot of enthusiasm at IPR. The day's events began with the flag hoisting ceremony. Dr. Shashank Chaturvedi, in his first official function after taking charge as the Director of IPR, hoisted the national tricolor which was followed by rendering of the National Anthem. Dr. Chaturvedi then addressed the gathering. He emphasized the fact that India is destined to be one of the top few economies in the world as scientists and technologists, we should try to be in the forefront of this growth as technology will play a major role in this. Shri P K Atrey, ACAO also addressed the gathering. This was followed by rendering of a patriotic song. After the flag hoisting event, snacks were served to the participants, followed by various other programmes for children of IPR staff.



Images of the flag hoisting ceremony and the Director's speech at IPR

[Click to view Director's Independence day speech](#)

70th Independence Day was celebrated as an institute function on 15th August, 2016 at CPP-IPR, Guwahati. Prof. K.S. Goswami, Centre Director unfurled the national flag after taking guard of honour by the security people.

The Centre Director encouraged his employee to come forward and help in the growth of the Centre during his short speech on the Independence Day after paying tribute to the freedom fighters and leaders of the Indian independence movement who had sacrificed their lives. Light refreshment was served after the flag hoisting ceremony.

The hoisted tricolor at CPP-IPR during the independence day celebrations



70th Independence Day Celebrations

As part of the I-Day celebrations, various activities such as slow-cycle race, musical chairs, painting and elocution were organized by the Staff Club for the children of IPR staff. An awareness program has been conducted on Independence Day about the risks and prevention of diseases that are spread by mosquitoes. Mr. George Kurien, State Entomologist, NVBDCP, Commissionerate of Health, Gandhinagar, Dr. V. K. Kohli, Entomologist, Ahmedabad Municipal Corporation, Mrs. Mamta. L. Dattani, District Malaria Officer, Gandhinagar and their associates gave informative talks on the subject.

Zydus Hospital provided free health check-up to IPR staff and family members, and more than 300 members took advantage of this medical check-up.



Some images of the post-flag hoisting programmes organized for IPR staff and family members



Dr. Shashank Chaturvedi

On behalf of all IPR staff, the IPR Newsletter extends a very warm welcome to Dr. Shashank Chaturvedi (SO/H+), who took charge as the third Director of IPR on 5th August, 2016. Prior to taking charge as the Director of IPR, Dr. Chaturvedi was heading the CAD(V), BARC Facilities at Visakhapatnam.

Having completed his B.Tech in Chemical Engineering (1st rank) in 1985 from IIT Delhi, he obtained his PhD in Chemical Engineering from Princeton University in the year 1989-90 in the area of Plasma Science & Technology Programme conducted jointly by PPPL and Princeton University.

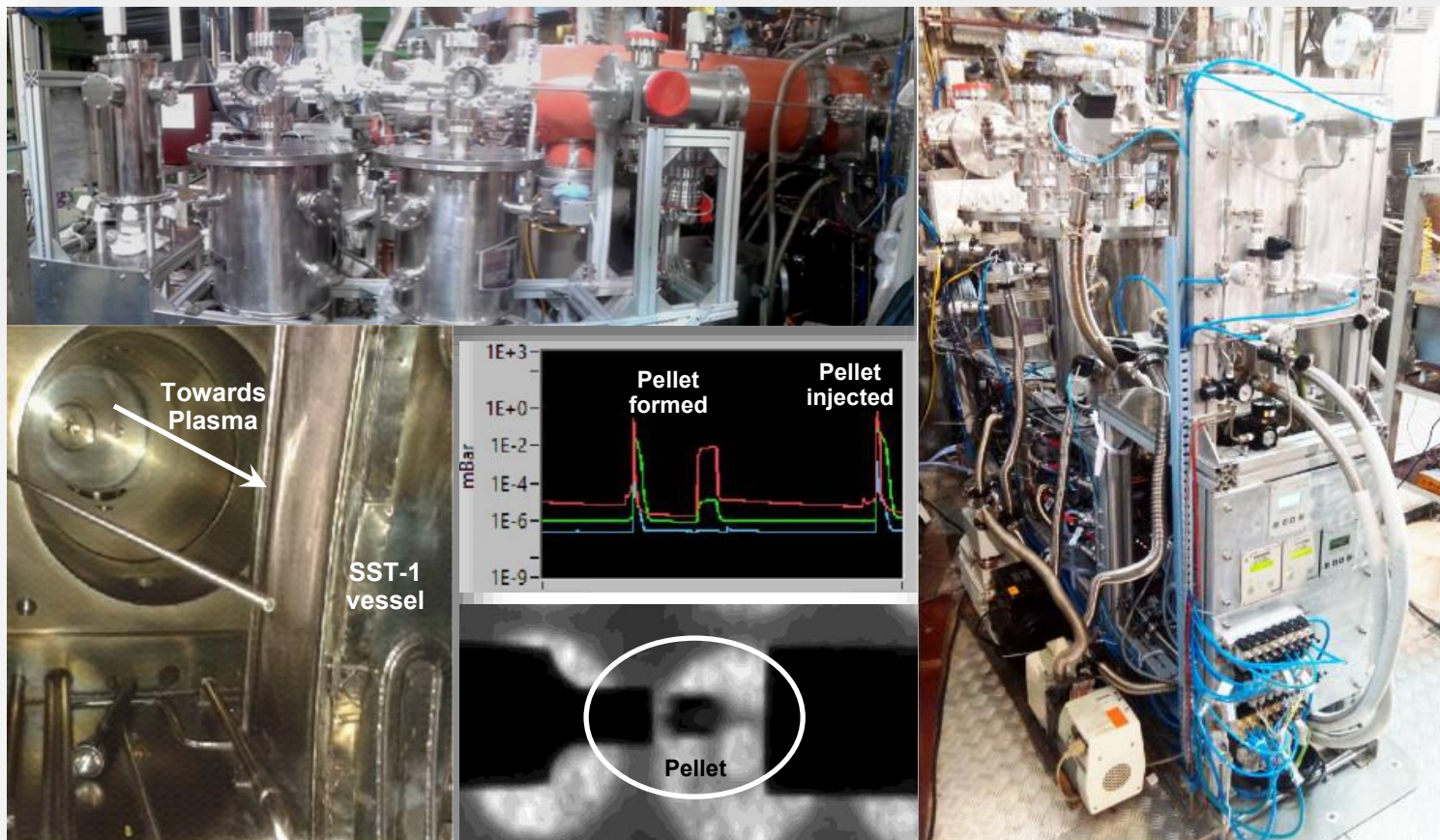
He joined IPR in November 1989 and was involved in R&D activities which included Tokamak modelling, modelling for pulsed power systems, shock waves, pulsed electromagnetics, radiation-hydrodynamics, plasma stealth, EMP simulators, development of HPC facilities etc. In July 2006, he was transferred to BARC and further, to the Visakhapatnam unit of BARC in 2009, where he was instrumental in setting up the Facility for Electromagnetic Systems.

Some of the projects he handled at BARC were ; Modelling of shock waves, modelling & experiments on high-velocity impact & penetration, theoretical generation of materials data (equation of state, radiation opacity, electrical resistivity) under extreme conditions of density, temperature and strain-rate, modelling of high-power microwave sources, Software development for Speech, Image & Video analytics, Development of High-performance computing facilities.

Some of the awards/honours that were conferred on Dr. Chaturvedi are ; Institute Silver Medal at IIT Delhi (1985), Homi Bhabha Science & Technology Award of DAE (2005), Group Achievement award of DAE and Elected as Fellow of Indian National Academy of Engineering (INAE) in 2013.

Integration of SPINS-IND Pellet Injector With SST-1

Fuelling by solidified form of hydrogen gas or its isotopes improves the density profile of high temperature plasmas by giving a peaked profile. Cryo pump and pellet injector division (CP&PI), IPR has successfully developed a single pellet injector SPINS-IND, capable of injecting cylindrical hydrogen pellets. The system is now integrated to SST-1 tokamak. SPINS-IND was successfully tested in laboratory for its performance. Injector design was upgraded and made compatible as per space availability and auxiliary systems integration in SST-1 tokamak environment on port number-7. It is an *in-situ* pipe gun type injector having structural dimension: 2.5 m (Length) $\times$ 0.47 m (width) $\times$ 1.8 m (height). System operational test was carried for its vacuum levels, and cryo-cooling capacity at the pellet freezing zone. Cylindrical pellets of dimension (2 mm length $\times$ 1.8 mm diameter) having speed 1000-1200 m/s and 4 mm pellets with a velocity of 750m/s were propelled using Helium as propellant. Further activities are in progress to have remote operation of the injector in an integrated environment with plasma discharge event.

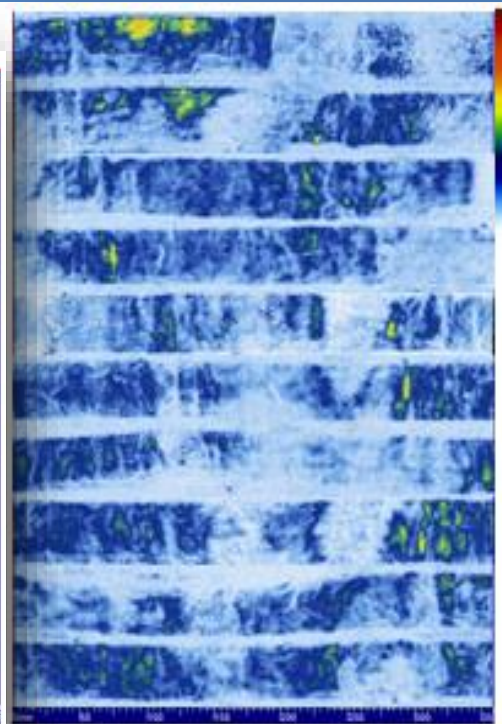
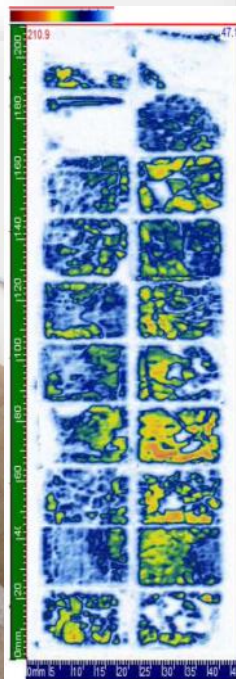
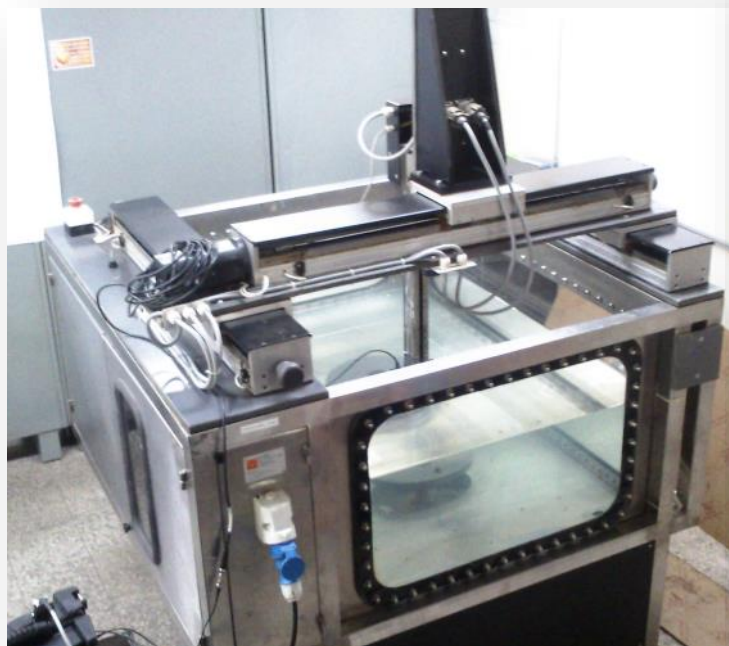


Clockwise from bottom left : Pellet flight tube inside SST1. Integrated view of the SPINS-IND pellet injector and view of the pellet being injected.

Ultrasonic testing is most promising non destructive testing method which utilized high frequency sound wave to characterize the integrity of structural materials and components. An Ultrasonic Test Immersion System is installed at Divertor and first wall Technology Development Division IPR. A system consists of Ultrasonic flaw detector coupled with high precision 6-axis manipulator to generate image of defects presents in material and Components. This Facility is successfully utilized (1) to check the integrity of various joints in Divertor plasma facing components at various stage of manufacturing as well as at in-service inspection (2) To optimize the various metal joining processes such as brazing, diffusion bonding, welding etc. (3) To characterize mechanical property of materials and (4) To inspect raw materials.

System Features

- High resolution Scan up to 0.05 mm step for C-scan imaging.
- Immersion tank area: 900mm x 700mm x 700mm with 300mm Dia. Turntable Rotating Chuck.
- A 6-axis manipulator for maneuvering the probe head.
- Scanning speed : 100mm/sec



(L) The Ultrasonic testing system (M) Cu-Cu interface and (R) Curved Cu-W interface as monitored by the device.

Millimeter Wave Test Facility @ IPR

Millimeter wave to THz spectrum has become of importance in various applications such as remote sensing, plasma diagnostics, and environmental measurements. Significant advances in microwave and millimeter wave technology have enabled the development of a new generation of diagnostics methods that measures both density & temperature profiles and their fluctuation components in magnetically confined plasmas.

This facility has state-of-the-art equipment such as (a) 8-244 GHz Vector Network Analyzer (b) 20-Hz-110GHz spectrum analyzer (c) 250 kHz-67 GHz signal generator (d) Power meters in the frequency ranges of 9kHz-110GHz and 110-220 GHz. This facility has developed various instrumentation for Interferometry, Radiometry, RADAR based reflectometry etc..



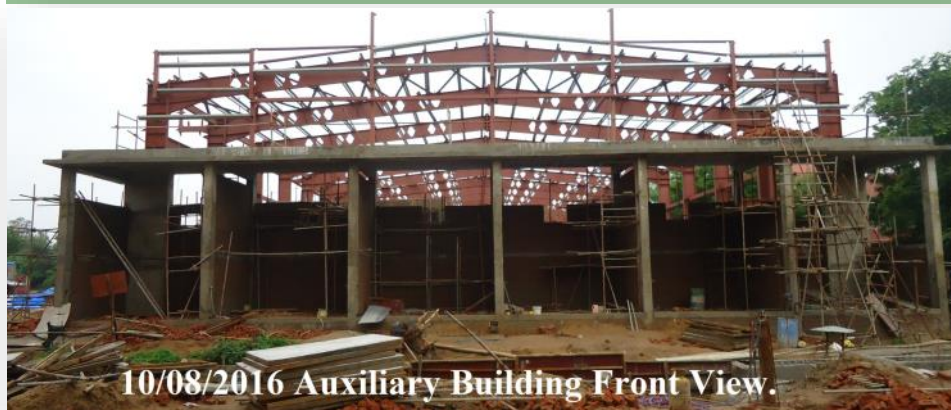
View of the instrumentation at the Millimeter Wave Test facility at IPR.

Institute for Plasma Research, Gandhinagar and Centre for Food Processing Technology & Bio-energy, Anand Agricultural University, Anand entered into a scientific collaboration agreement on 26th July, 2016 at IPR, Bhat campus. The agreement was signed by Dr. D. C. Joshi, Dean of College of FPTBE, AAU and Prof. Amita Das, Dean - IPR and being witnessed by Prof. Dhiraj Bora. The scope of this agreement covers joint collaboration and research on development of plasma based technologies for surface decontamination of fruits and vegetables. Cross-disciplinary expertise of both IPR and AAU will be helpful to reduce the pesticide contamination on fruits and vegetables, which is a growing health concern across the nation. The outcome of the agreement will benefit the agro sector of the country as well as to the health of the public.



(L-R) Dr. D. C. Joshi, Prof. Dhiraj Bora and Prof. Amita Das, during the signing of the scientific collaboration at IPR

Campus Construction Update



10/08/2016 Auxiliary Building Front View.



10/08/2016 Pump House Building.



10/08/2016 Laboratory Building.

Construction of the Pre-Engineered buildings (Laboratory Building and Auxiliary building) are progressing and the metal superstructure of the auxiliary building has been completed and that of the laboratory building is in progress. The pump house and the water tanks are in the final stages of completion.



10/08/2016 Laboratory building



29/07/2016 Auxiliary Building Top view.

Welcome To The New PhD and TTP Students

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On behalf of IPR, the newsletter team extends a very hearty welcome to all the new PhD scholars and technical trainees who joined IPR from 1st August 2016. We welcome them to the IPR family and we hope that your next few years at IPR will be the best years of your life. We wish you all the best in your career !

						
Ayushi Vashistha PhD Scholar	Devshree Mandal PhD Scholar	Hariparasad M G PhD Scholar	Md. Rejaul Karim PhD Scholar	Nidhi Rathee PhD Scholar	Pawandeep Kaur PhD Scholar	Pradeep Bairagi PhD Scholar
						
S. K. Pandey PhD Scholar	Satadal Das PhD Scholar	S. Karmakar PhD Scholar	Swapnali K PhD Scholar	Tanmay Macwan PhD Scholar	Debrup M PhD Engg	Piyush P. PhD Engg
						
Pranjal Singh PhD Engg	Samkit Jain TTP	Sayeesh T. M. TTP	Sneha Gupta TTP	Vishal Gupta TTP	Devikal Kumawat TTP	S. Upadhyay TTP

IPR Divisions & Groups - Civil Maintenance Group



Formed in 1987, the IPR Civil Maintenance Group (CMG) is responsible for the maintenance of over 45,000 Sqm of the main IPR campus, as well as the IPR hostel, Guest house, FCIPT, ITER India, IPR laboratory Extension buildings. They are also responsible for the landscaping of the campus. Their campus development and maintenance activities include public health and environmental protection related jobs, as well as day to day civil maintenance, renovation / modification works while taking care to maintain the overall aesthetics of the premises. This group also takes care of the casual labour requirement of IPR. They also take care of the requirements of special functions and events that happen frequently at the Institute.

(L to R) Mr. Mr. Bindesh M. Parmar , Mr. Subodh M. Patel , Mr. Gumansinh M. Gohil

2nd PFRC Workshop on Lithium Ceramics for Tritium Breeding (LCTB-2016)

The 2nd PFRC workshop on lithium ceramics for tritium breeding was conducted at IIT Madras during 23-24 August 2016 under the auspices of PFRC-BRNS. The first meeting in this series was organized at NIT-Rourkela in 2011. This thematic meeting focused on various aspects of the topic and was represented by all the groups in India working on lithium ceramics for tritium breeding, funded through PFRC projects. The R&D work on lithium ceramics is a very important component of the Indian Test Blanket Module (IN-TBM). This meeting was attended by over 25 participants.



Dr.Paritosh Chaudhury delivering the invited talk "Status and required R&D on tritium breeder for fusion reactor"

IPR's delegation was led by Dr. Paritosh Chaudhury and was attended by B. Riscob, Aroh Shrivastava and Suraj Gupta, who also presented their work carried out at IPR. Members of PFRC, Prof. T. Jayakumar and Dr. Ravi A V Kumar also attended the meeting. Two panel discussions, one on fabrication and characterization and another on modeling & simulation of lithium ceramics for tritium breeding were also organized as part of this workshop to help NFP draft future programs in these areas.



(L) The HOD, Physics IIT-M, addressing the meeting (R) Participants of the 2nd PFRC Workshop on LCTB-2016

Aditya Upgrade - Update

Aditya Control room was renovated during Aditya Machine Upgrade work. As part of upgrade work Aditya Control room infrastructure upgraded for civil, air conditioning, grounding and for domestic electrical work. For more interaction between the users during Aditya operation, the control room is now equipped with a interactive board and a video wall. A server room and an emergency exit door with external staircase was also build. A new utility power distribution network was installed to meet the additional needs of more power points and safety requirements. In the new control room, around 25 users can now be accommodated to work during Aditya operation. Individual diagnostic data acquisition system has also been integrated into the new setup without disturbing the existing common data acquisition system. CAMAC and VXI based data acquisition system racks have been transferred to the Aditya hall to reduce cable length and easier access of the system. Acquisition PC is interfaced using fiber optic connectivity to separate Tokamak and Control room grounding systems. Vacuum control system has now been automated and installed in the control room. To comply with safety, access control system and security CCD cameras have been installed.



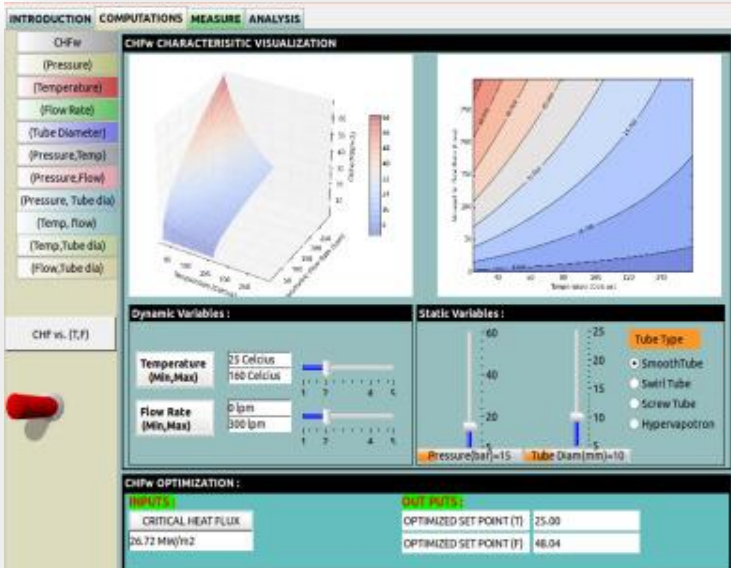
(L) The upgraded Aditya control room showing the interactive board and video wall. (R) The enclosure for locating the Aditya servers

Development of a Computational Toolkit for High Heat Flux Testing of Divertor Mockups

High heat flux testing of Plasma Facing Components viz. Divertor & First Wall components, is a challenging engineering problem of a tokamak. During tokamak operation, these components are subjected to steady state as well as transient heat loads of very high magnitude. Therefore, accurate prediction and control of the coolant parameters is crucial to prevent burnout. A computational toolkit called SIMP is developed at IPR to predict the coolant flow parameters for given input heat flux conditions and mockup geometry under given experimental constraints.

The software solves the Critical Heat Flux (CHF) model and performs curve fitting based on the standard NIST fluid data. SIMP software is developed based on the interface of EPICS and Python based tools. The software is currently under operation at High Heat Flux Test Facility (HHFTF) at IPR.

Optimized set points for input Critical heat flux calculated from mockup geometry and power inputs



- ◆ 7th International Symposium on Nonequilibrium Processes, Plasma, Combustion and Atmospheric Phenomena (NEPCAP 16), Sochi, Russia, 2-7 October 2016 <http://www.nepcap2016.ciam.ru/>
- ◆ 2016 North American Particle Accelerator Conference (NA-PAC'16), Chicago, Illinois USA, 9-14 October 2016 <https://napac2016.aps.anl.gov/>
- ◆ 69th Annual Gaseous Electronics Conference, Bochum, Germany, 10-14 October 2016 <http://www.gec2016.de/>
- ◆ 7th International Plasma Nanoscience and Nanotechnology Conference (iPlasmaNano-VII), Vravrona, Greece, 12-16 October 2016 <http://www.iplasmanano.org/>
- ◆ 26th IAEA Fusion Energy Conference, Kyoto, Japan, 17-22 October 2016 <http://www-pub.iaea.org/iaea-meetings/48315/26-th-IAEA-Fusion-Energy-Conference>
- ◆ 58th Annual Meeting of the APS Division of Plasma Physics, San Jose, California USA, 31 October - 4 November 2016 <https://www.aps.org/units/dpp/meetings/annual/>
- ◆ 20th International Conference on Ion Beam Modification Of Materials (IBMM 2016), Wellington, New Zealand, 31 October - 4 November 2016 <http://www.ibmm2016.nz>

Past Events @ IPR

- ◆ **Dr. Sanat Kumar Tiwari**, Department of Physics and Astronomy, University of Iowa, U.S.A, gave a talk on "*Thermodynamic State Variables in Ultracold Plasmas*" on 27th July 2016
- ◆ **Dr. Arvind Kumar Saxena**, Max-Planck Center for Attosecond Science, POSTECH, South Korea, gave a talk on "*Study of Clusters using Mass Spectrometry, Optical Spectroscopy and Imaging technique*" on 05th August 2016
- ◆ **Dr. Karan Pankaj Jani**, Georgia Institute of Technology-USA, LIGO Scientific Collaboration, gave a talk on "*Journey of Binary Black Holes: From Supercomputer to LIGO to Universe*" on 23rd August 2016
- ◆ **Mr. Vikram Singh Dharodi**, Institute for Plasma Research, Gandhinagar, gave a talk on "*Collective phenomena in strongly coupled dusty plasma medium*" on 24th August 2016

Know Our Colleagues



Dr. Amit Sircar joined IPR in January 1997 with Aditya Operation Group. He became Head of Aditya Operation Group in the same year and contributed significantly towards improving Aditya discharges. In 2003 he joined SST-1 Operation Group. He proposed a measurement device consisting of circular array of pick-up coils to measure radial and vertical error fields of any coil or coil pairs. He also developed an electron beam method for measuring average error field of the toroidal magnetic field and successfully demonstrated the same in BETA device. This method has also been used in Aditya. During 2006-08, he pursued post-doctoral research at the Department of Physics, Washington University in St Louis, USA. He designed and fabricated a highly sensitive torsion balance to measure very weak gravitational forces which can test Einstein's equivalence principle with more sensitivity than the models developed earlier. He returned to IPR in 2008 and joined the Test Blanket Module (TBM) Division with the responsibility of Tritium Extraction System (TES) and other Tritium related activities for LLCB TBM and subsequently led the Tritium Technologies Section of TBM Division. Since 2012 he is independent head of the newly formed Fusion Fuel Cycle Division and has developed many experimental setups for developing Tritium Technologies needed for the Indian TBM and DEMO reactor. In 2012, he became independent Head of the newly formed Fusion Fuel Cycle Division and has developed many experimental setups for developing Tritium Technologies needed for the Indian TBM and DEMO reactor.

Dr. Rajesh Kumar, with a doctorate from Loughborough University U.K in the field of plasma as switching component for gigawatt electrical power transfer, first joined IPR in 1995 as a technical trainee and later on in 1996 as a scientist in the erstwhile pulsed power group that was in its inception stage. The Pulse power group was then involved in study of pulse power driven concepts including industrial applications like rock fracturing with under water electrical discharges. In a maiden effort of generating fusion (D-D) neutrons in IPR, he had operated plasma focus to produce pulsed neutrons. In 2000-2001 he was at Institute for Plasma Physics and Laser Microfusion, Warsaw, Poland under UNESCO fellowship for six months. Currently he is working in Pulsed Power and Development of RFQ for Accelerators group. Generation of high power microwave and application of pulsed power in electromagnetic welding is his core area of work.



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