Issue 088

November 2020

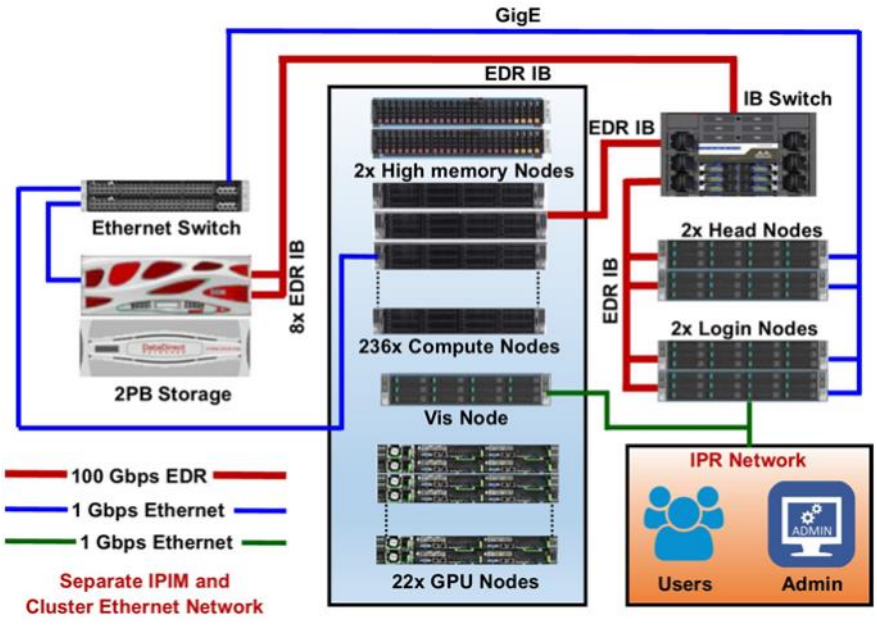
# The Fourth State

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

## High Performance Computing (HPC) Facility at IPR

Considering the importance of High-Performance Computing (HPC) in accelerating the process of scientific discoveries, IPR has recently established a computational cluster facility with approximately 1 PetaFlops (1PF) theoretical peak compute capability. This 1PF HPC system named, as ***ANTYA*** having more than 10000 cores can perform $10^{15}$ FLoating-point Operations Per Second (FLOPS). It is housed in IPR Data Center with 24x7 operations. The name ANTYA has been derived from Sanskrit language and means $10^{15}$. More than 20 HPC applications from various science and engineering domains have been successfully installed and tested to demonstrate the parallel capabilities of ANTYA. These applications include highly scalable open-source codes, in-house developed codes and the commercial licensed software. Several of these codes exhibited a near-linear scaling. ANTYA is now fully operational on a 24x7 basis, and is being used for a variety of numerical simulations covering computational fluid dynamics, particle-in-cell, Molecular Dynamics, MHD, AI/DL *etc.*

The "ANTYA" HPC system




**In July, 2020, ANTYA was ranked 11th in the list of top supercomputers in India**

***http://topsc.cdacb.in/jsps/july2020/index.html***

(L) Architecture of the "ANTYA" HPC system

# HPC Facility at IPR - Scaling & Testing



| System Configuration | | |
|---|---|---|
| Type of Nodes | Qty | Processor & RAM |
| Login Node | 02 | 2 x Intel Xeon Gold 6148 (20 core, 2.4 GHz) & 384 GB RAM<br>1 x Nvidia Tesla P100 GPU PCIe with 16 GB RAM |
| Compute Node | 236 | 2 x Intel Xeon Gold 6148 (20 core, 2.4 GHz) & 384 GB RAM |
| GPU Node | 22 | 2 x Intel Xeon Gold 6148 (20 core, 2.4 GHz) & 384 GB RAM<br>2 x Nvidia Tesla P100 GPU PCIe with 16 GB RAM |
| High Memory Node | 02 | 4 x Intel Xeon Gold 6148 (20 core, 2.4 GHz) & 1024 GB RAM |
| Visualization Node | 01 | 2 x Intel Xeon Gold 6148 (20 core, 2.4 GHz) & 384 GB RAM<br>2 x Nvidia Tesla P40 w 24 GB RAM |
| Management Nodes | | |
| Head Node | 02 | 2 x Intel Xeon Gold 6148 (20 core, 2.4 GHz) & 384 GB RAM |
| Storage | | |
| GPFS high performance storage of 2 PetaByte (2PB) as HPC storage | | |
| Computational & Management Network | | |
| 100Gbps EDR IB Mellanox 1 Gbps Ethernet | | |

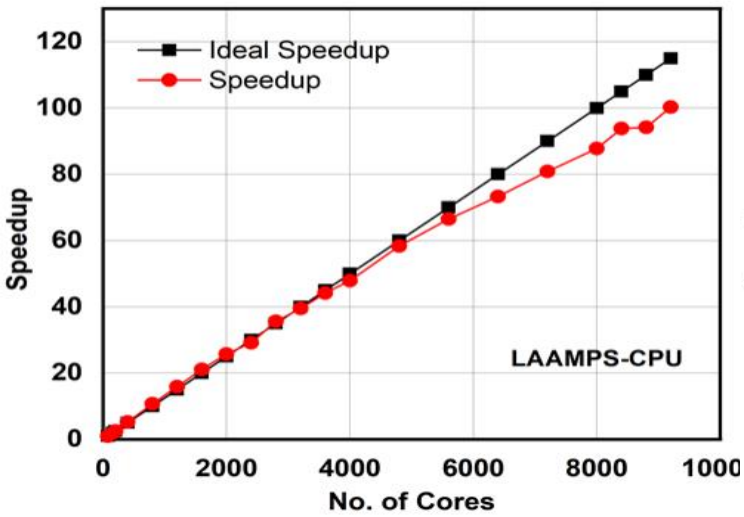
| Libraries/ Compilers | Open Source Codes | Commercial Licensed Soft-ware |
|---|---|---|
| AccFFT | LAMMPS CPU & GPU | ANSYS |
| Anaconda | PLUTO | COMSOL |
| Blas | Paraview | CST |
| CUDA | NAMD CPU and GPU | MATLAB |
| FFTW | OpenFOAM & Salome | IDL |
| GCC & gnuplot | VMD | In-house devel-oped Codes |
| Intel paral-lel studio | Xoopic | GMHD3D |
| Lahey FORTRAN | BOUT++ | PEC2PIC |
| Mpich | Darknet-YOLO Code | GTS (in collab-oration) |
| Openmpi | RASPA2.0 | MPMD-2D & 3D |
| Openblas | R/6.3.0 | EPPIC Codes |
| petsc | Visit | OpenFOAM solvers |
| PGI | AI/DL/ML frameworks | |
| HDF5 | python385 | |
| NetCDF | Hpl2.2 | |
| pnetcdf | octave | |

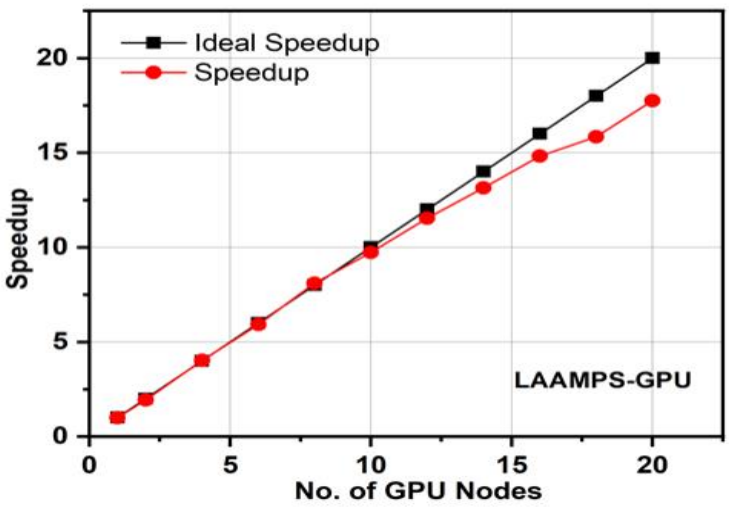
(L) Configuration of ANTYA HPC System (R) Libraries, codes and software available on ANYTA.

| COMSOL Simulations | # Nodes | # Cores | Computation Time |
|---|---|---|---|
| Simulation-1 | 3 | 120 | 4 hours 20 min |
| Simulation-2 | 6 | 240 | 2 hours 57 min |

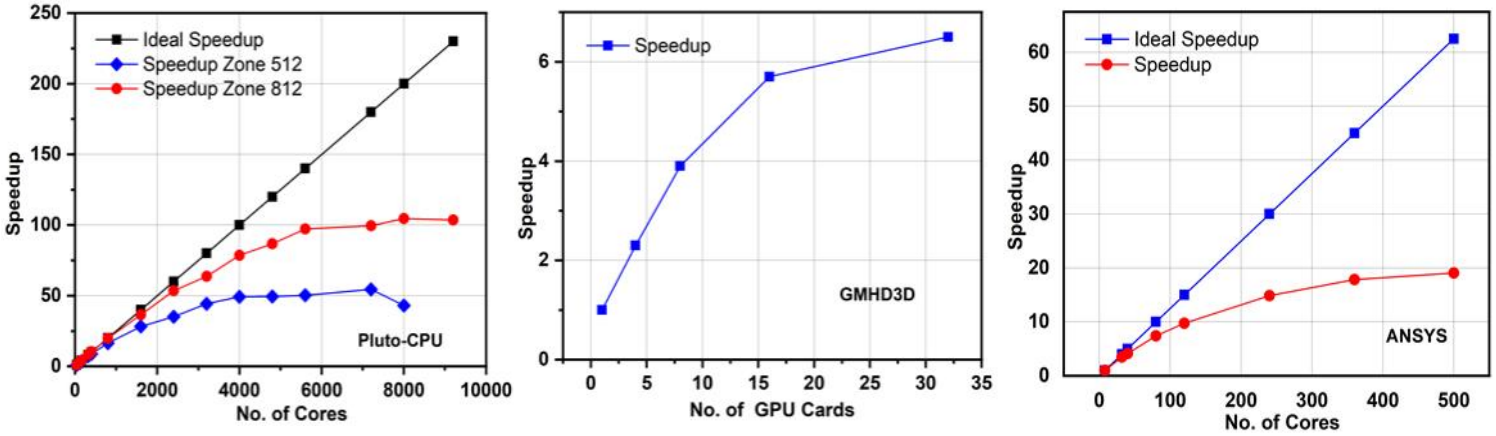
| Solver Name | 1 CPU node | 1 GPU node |
|---|---|---|
| CST PIC solver | 10 hrs 22 min | 37 min 58 sec |
| Transient solver | ~ 14 hours | ~6 hrs 48 min |

ANTYA scaling for (L) COMSOL (R) CST solver

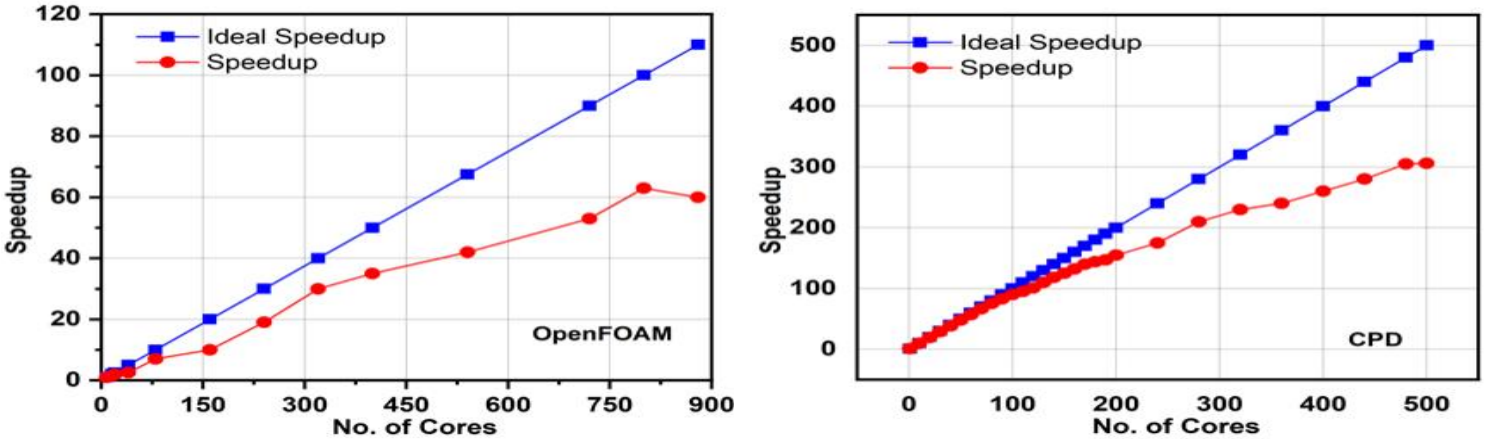



Scaling and testing of codes on ANTYA (L) LAMMPS CPU and (R) LAMMPS GPU




Scaling and testing of codes on ANTYA (L) PLUTO Code and (M) GMHD3D (GPU MHD) and (R) Ansys Code with respect to number of CPU cores/GPU nodes




Scaling and testing of codes on ANTYA (L) Parallelized Electrostatic Cartesian 2-D Particle-In-Cell (PEC2PIC) Code (R ) 3-D Charged Particle Dynamics (CPD) Code

IPR Data-Center where the ANTYA HPC is installed.

## उपलब्धि

हिन्दी विज्ञान साहित्य परिषद, भाभा परमाणु अनुसंधान केंद्र, मुंबई द्वारा आयोजित *"डॉ होमी भाभा विज्ञान लेख प्रतियोगिता 2019"* (अखिल भारतीय आधारित) के लिए संस्थान की **सुश्री प्रतिभा गुप्ता**, वैज्ञानिक अधिकारी-एफ को *"सुपरकंडक्टर्स की अद्भुत दुनिया"* आलेख के लिए तीसरे पुरस्कार से पुरस्कृत किया गया है। पुरस्कार के रूप में 4000 रुपये का एक चेक और प्रमाणपत्र प्रदान किया गया है। इस आलेख को भाभा परमाणु केंद्र के सौजन्य से प्रकाशित हिन्दी विज्ञान साहित्य परिषद की पत्रिका "वैज्ञानिक" में प्रकाशित किया जाएगा।

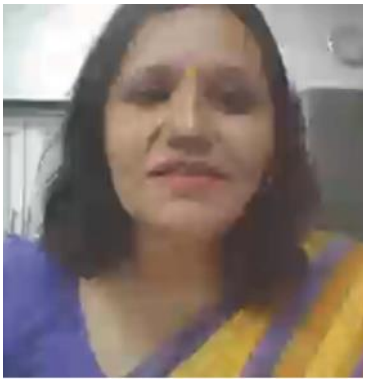
**Prof. Shishir P Deshpande**, has been appointed to the Board of Editors of the Journal "*Nuclear Fusion*" until December 2023.

(L) **Dr. Mainak Bandyopadhyay** (M) **Dr Shantanu Karkari** and (R) **Dr. Jervis R Mendonca** have been accorded the "Trusted Reviewer" status by IOP Publishing. This is to recognize the very best peer reviewers in the physical sciences. This recognition is given to only the top 15% of the reviewers of IOP publications. Congratulations !

## राजभाषा के क्षेत्र में नराकास, गांधीनगर स्तर पर उपलब्धि

नगर राजभाषा कार्यान्वयन समिति की **15**वीं छमाही बैठक 24 सितंबर, 2020 को बड़ौदा एपैक्स अकादमी, गांधीनगर द्वारा माइक्रोसॉफ्ट टिम्स के माध्यम से ऑनालाइन आयोजित की गई, जिसमें श्री दीपांकर गुहा, नराकास अध्यक्ष एवं प्रमुख, बड़ौदा एपेक्स अकादमी, डॉ. सुस्मिता भट्टाचार्य, उपनिदेशक, क्षेत्रीय कार्यान्वयन कार्यालय, मुंबई एवं गांधीनगर स्थित केन्द्र सरकारी कार्यालयों/उपक्रमों/बैंकों/संस्थानों के प्रमुख एवं प्रतिनिधि उपस्थित थे। इस बैठक में नराकास, गांधीनगर स्तर पर राजभाषा के क्षेत्र में श्रेष्ठ कार्यनिष्पादन हेतु वर्ष 2019 के पुरस्कारों की घोषणा की गई।

राजभाषा के क्षेत्र में श्रेष्ठ कार्यनिष्पादन हेतु वर्ष 2019 के लिए **प्लाज़्मा अनुसंधान संस्थान** ने **प्रथम पुरस्कार** प्राप्त किया है। इस बैठक में संस्थान के निदेशक एवं हिंदी अधिकारी ने भाग लिया था। नराकास, गांधीनगर स्तर पर आयोजित प्रतियोगिताओं के विजेताओं की घोषण भी इस बैठक में की गई। कार्यालय प्रधान आयकर आयुक्त, गांधीनगर द्वारा 19 नवंबर, 2019 को आयोजित चित्र देखो, कहानी लिखो प्रतियोगिता में संस्थान के **डॉ. रितेश सुगन्धी, वैज्ञानिक अधिकारी – एफ** ने **प्रथम पुरस्कार प्राप्त किया** है।

डॉ. सुस्मिता भट्टाचार्य, उपनिदेशक, क्षेत्रीय कार्यान्वयन कार्यालय, मुंबई, निदेशक, आईपीआर एवं नराकास, गांधीनगर के सदस्य कार्यालय के प्रमुख एवं प्रतिनिधि

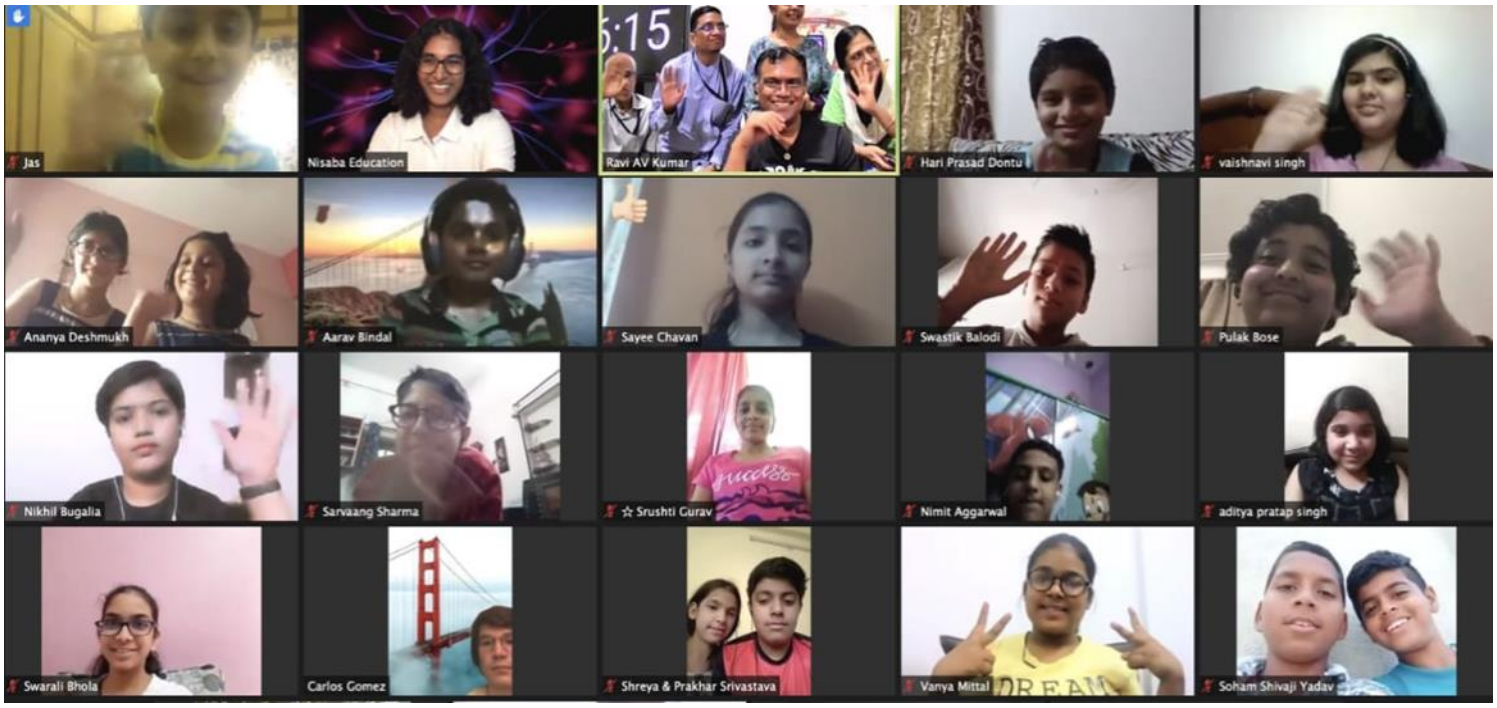
# अंतर अनुभागीय चल राजभाषा शील्ड

राजभाषा के क्षेत्र में उत्कृष्ट कार्य करने हेतु वर्ष 2019-2020 के लिए अंतर अनुभागीय चल राजभाषा शील्ड भंडार अनुभाग(स्टोर सेक्शन) को प्रदान की गई। डॉ. शिशिर देशपांडे, डीन प्रशासन द्वारा शील्ड ग्रहण करते हुए श्री योगेश दाधीच, सहायक भंडार अधिकारी एवं अन्य स्टाफ सदस्य |

## IPR Outreach

**Outreach webinar programmes conducted during the month of September-October 2020**

| Date | Institution | Programme | Participants |
|---|---|---|---|
| 24-25 Sept,2020 | Bhavan's Vidyalaya group of Schools, Kochi, Kerala | 2-day, 4 hour webinar on Plasma & its Applications | 59 science teachers of Bhavan's Vidyalaya group and other schools in Cochin. |
| 8-9-Oct, 2020 | Mar Thoma College for Women, Perumbavoor, Kerala | 2-Day, 4 hour webinar on Plasma & its Applications | 60 BSc Physics students and 2 teachers |
| 14-Oct, 2020 | General Participants from Kerala, Andhra Pradesh and Gujarat | 1day, 4 hour webinar on Plasma & its Applications | 46 students (XII, BSc, MSc, MPhil) and 7 teachers |
| 21-Oct-2020 | Children of 8-12 years from various parts of India and other countries, coordinated by Nisaba Education Foundation, Pune. | Special 1 hour programme on Plasma with emphasis on experiments. | 40 children of age group 8-12 years and one coordinator. |



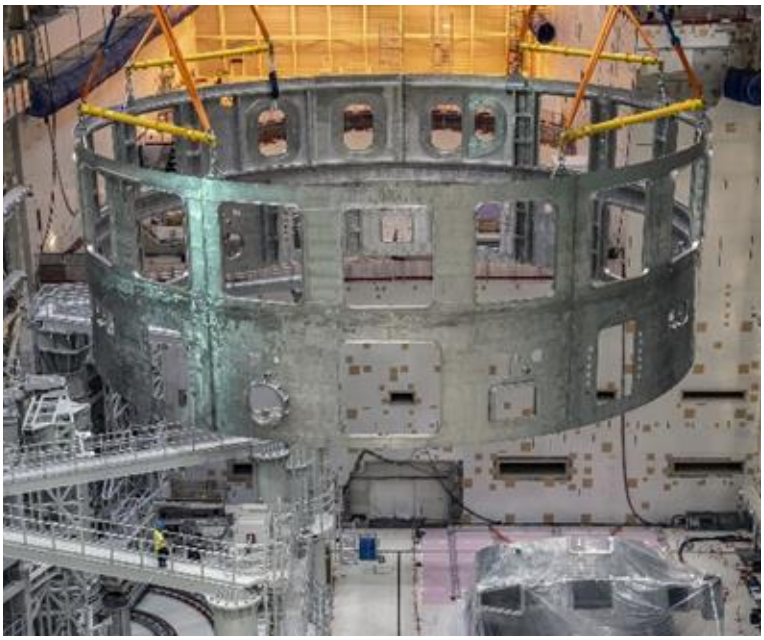
# Installation of ITER Cryostat Base Section in the Tokamak Pit

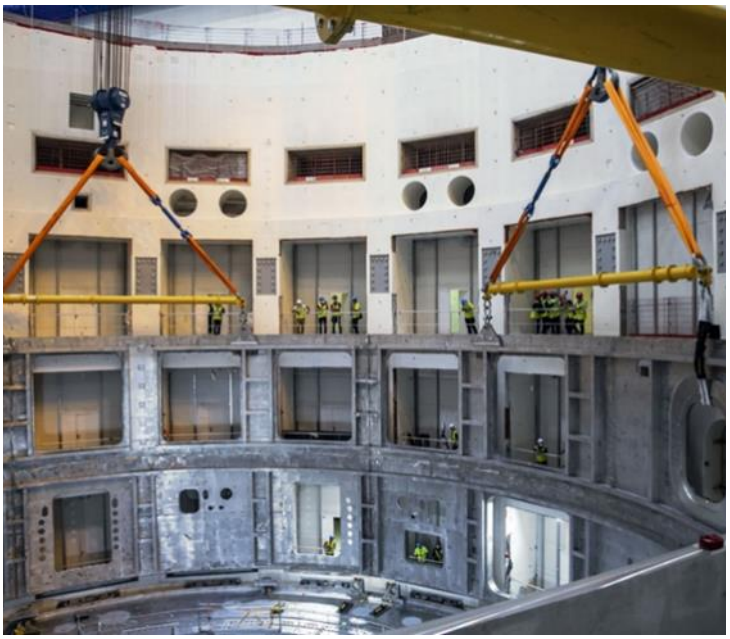


Further to installation of Cryostat Base Section in May 2020, now the Cryostat Lower Cylinder, was installed in the Tokamak pit in the first week of September 2020.

The structure weighing approx. 400 tons, was placed with high positional accuracy. Each step has been carried out with care and accuracy. The final positioning of the Lower Cylinder has been carried out, lowering it the final few centimeters very carefully so that it can be joined to the Cryostat Base (the average root gap with the perfect positioning between the two parts is below 5 mm in the Z direction and in the X-Y directions the offsets are also well within the acceptable tolerance). This is remarkable achievement for circular parts with 30 meters diameter and weight of several hundreds of tons. This feat now marks the half of the Cryostat sections (Base and Lower Cylinder) being placed in Tokamak pit for further assembly and integration operations of ITER

This milestone also marks the start of ITER Tokamak assembly.





Lifting and Installation Operation of Cryostat Lower Cylinder in Tokamak Pit

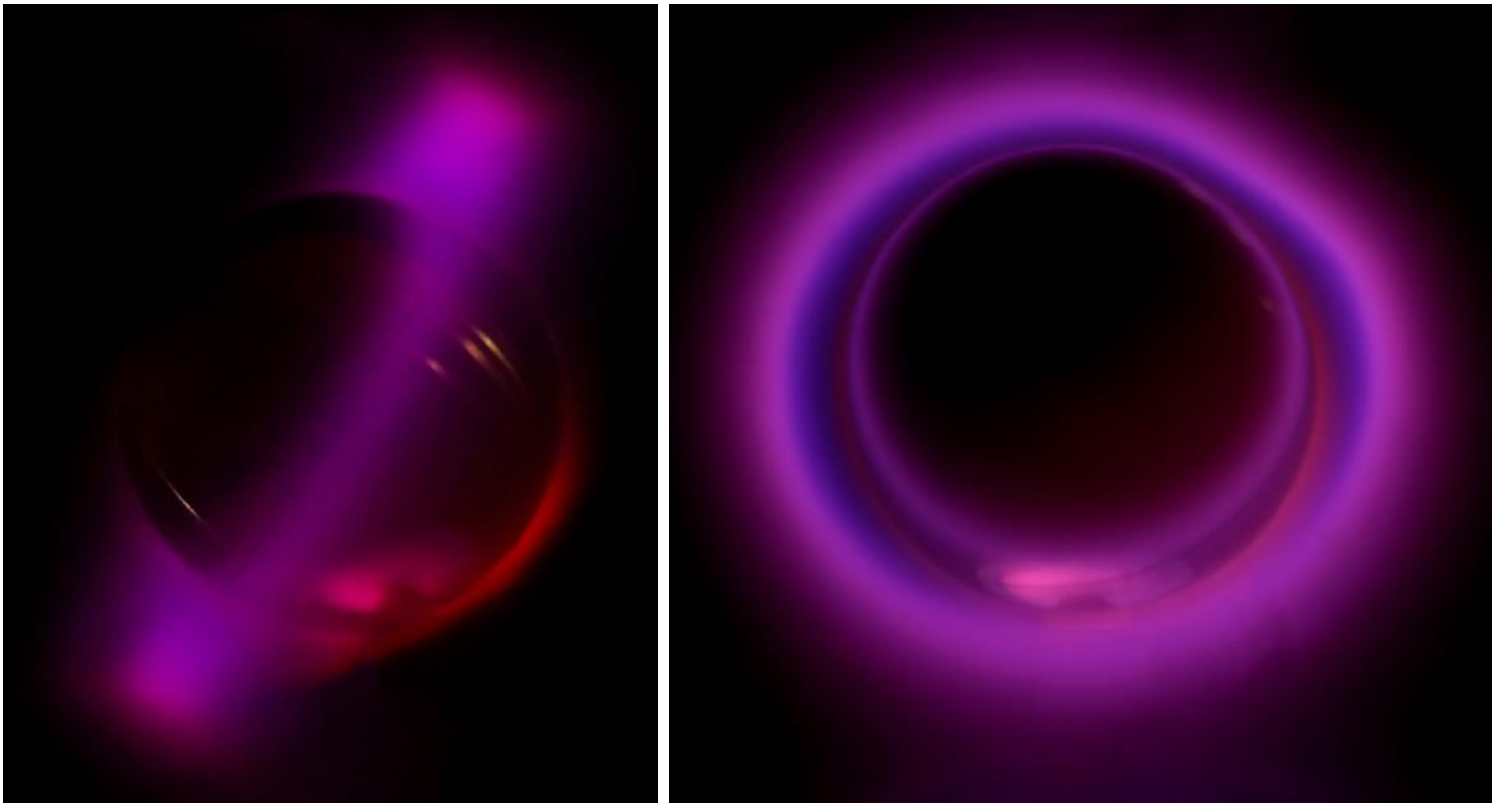
## Past Events @ IPR

- ***Mr. Pranjal Singh*** gave a webinar talk on "*Probe for in situ measurement of work function and Cs dynamics*" at 7th International symposium on Negative ions, Beams and Sources (NIBS'20), on 02nd September 2020
- ***Mr. Ansh Patel and Mr. Santosh Pandya*** gave a Poster Presentation on "*Simulation of runaway electron distribution function following massive gas injections in ITER-like tokamak and beam energy dissipation*" at International e-Conference on Plasma Theory and Simulations (PTS-2020), Guru Ghasidas Central University, Bilaspur, on 15th September 2020
- ***Mr. Vinit Shukla*** gave a Poster Presentation on "*Numerical Simulation to Estimate the Tritium Permeation in Stainless Steels in Fusion Devices*" at 31st Symposium on Fusion Technology (SOFT2020), Virtual Edition, on 21st September 2020
- ***Dr. Rajwinder Kaur*** gave a talk on "*Nuclear Fusion: The Perennial Source of Clean Energy*" organized by IISERB Physics Club, Indian Institute of Science Education and Research, Bhopal on 25th September 2020
- ***Dr. Kaushik Choudhury***, Monash University, Melbourne, Australia, gave a talk on "*Interferometric Observation of Laser-Plasma Induced Shockwaves And Laser Confocal Imaging*" on 1st October 2020
- ***Dr. Suman Chatterjjee***, NIT, Rourkela, gave a talk on "*Laser Material processing of Advanced Engineering Materials*" on 9th October 2020
- ***Dr. Ashis Manna***, Institute of Physics, Bhubaneswar, gave a talk on "*Ion implanted TiO2, ZnO thin films for investigating structural phase transition, dynamics of surface evolution, resistive switching and photo-absorbance property*" on 21st October 2020
- ***Dr. Vikram Dharodi***, Post Doc. Fellow, Michigan Sate University, USA, gave a talk on "*Sculpted Ultracold Neutral Plasmas*" on 23rd October 2020
- ***Dr. Gaurang Joshi***, Pandit Deendayal Petroleum University (PDPU), Gandhinagar, gave a talk on "*Developments of friction stir welding process for dissimilar copper - stainless steel Joints"* on 29th October 2020

## Upcoming Events

- 3rd Asia Pacific Symposium on Tritium Science (APSOT-3), University of Toyama, Japan, 3-6 November 2020 http://www.hrc.u-toyama.ac.jp/apsot/index.html
- 62nd Annual Meeting of the APS Division of Plasma Physics, (Virtual Meeting), 9-13 November 2020 https://engage.aps.org/dpp/meetings/annual-meeting
- 2020 American Nuclear Society Virtual Winter Meeting, Two virtually-colocated conferences are also included: Technology of Fusion Energy (TOFE) 2020 and The Consortium for Advanced Simulation of Light Water Reactors (CASL), 16-19 November 2020 https://www.ans.org/meetings/wm2020/
- Fusion High Performance Supercomputing (HPC) Workshop, 27th November 2020 https://fusenet.eu/event/fusion-hpc-workshop-2020
- Modeling, observing and understanding flows and magnetic fields in the Earth's core and in the Sun, 30th November 2020 to 4th December 2020 https://www.newton.ac.uk/event/dytw03

## Terrella @ IPR Outreach

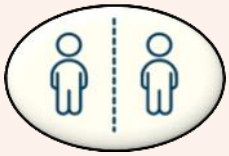


Preliminary images of the Terrella device developed by Outreach Division.
(L) Side view (R) Top view of the ring current around the equatorial line of a hollow sphere with a magnet.

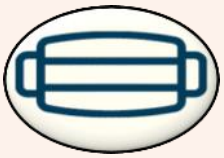
| Title | Page No | Title | Page No |
|---|---|---|---|
| ANTYA HPC System | 1-3 | Installation of ITER Cryostat Base Section | 6 |
| उपलब्धि (हिन्दी विज्ञान साहित्य परिषद) | 3 | Past Events @ IPR Outreach | 7 |
| Accolades ( Journal reviewers) | 4 | Upcoming Events | 7 |
| राजभाषा के क्षेत्र में नराकास, गांधीनगर स्तर पर उपलब्धि | 4 | Terrella @ IPR | 7 |
| अंतर अनुभागीय चल राजभाषा शील्ड | 5 | Obituary | 8 |
| Outreach Activities | 5 | | |


## Help Fight The Covid-19 Pandemic

**Wash Your Hands With Soap**



**Ensure Social Distancing**



**Always Wear Mask**

- 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
- Inform office if you or any of your family members test positive.

## Obituary

**Shri Mahesh Kushwaha**
**( 13 Sept 1970 — 12 Oct 2020)**

**Shri Mahesh Kushwaha,** Scientific Officer-G, passed away on 12th October, 2020 at Ahmedabad due to a massive heart attack. He joined IPR as technical trainee in 1995 and as an engineer in 1996. He started his career in RF Group and worked on all three RF systems (ECRH, LHCD and ICRH). Shri Kushwah's contribution in scientific field is remarkable as he has developed many high voltage systems like series of ignitron crowbar system, design and development of several high voltage power supplies like anode modulator power supplies for Gyrotron and Klystron.

He had worked in ITER-India ECRH system where he has given his valuable technical contribution on high voltage system for ITER Gyrotron. He has also worked in ITER-France for five years and contributed to ITER system on High voltage system for RF heating system of plasma. Recently he was working in ECRH division and giving his valuable technical contribution on ECRH experiments on SST-1 and Aditya-U. He was working on the development of latest technologies like development of solid state crowbar, solid state switch etc. for the safe and reliable operation of Gyrotron for ECRH systems. His sudden demise has been a great shock to all of us and has left behind a vacuum which cannot be filled easily!

We pray that his soul rests in eternal peace !


## The IPR Newsletter Team

| | | | | | | |
|---|---|---|---|---|---|---|
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