December 2019

अणुविद्या

HBNI NEWSLETTER

होमी भाभा राष्ट्रीय संस्थान

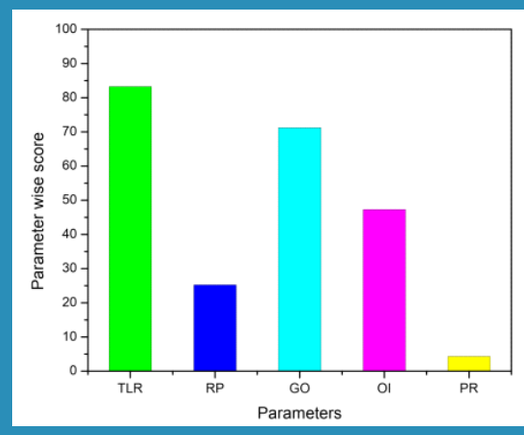
Homi Bhabha National Institute

(परमाणु ऊर्जा विभाग की एक सहायक संस्था और यूजीसी
अधिनियम 1956 की धारा 3 के तहत विश्वविद्यालय माना जाता है)

(An aided institution of the Department of Atomic Energy and
a Deemed-to-be university under section 3 of the UGC Act.1956)

NIRF Ranking

HBNI is regularly participating in India Ranking by National Institutional Ranking Framework (NIRF) since its inception in 2015. NIRF outlines a methodology to rank institutions across the country based on various parameters. These parameters broadly cover Teaching, Learning and Resources (TLR), Research and Professional Practice (RP), Graduation Outcomes (GO), Outreach and Inclusivity (OI) and Perception (PR). In last four years, HBNI has been consistently performing well.



Marks scored by HBNI under various parameters in NIRF 2019

MISSION

To encourage the pursuit of excellence in sciences (including Engineering Sciences) and mathematics in a manner that has major significance for the progress of indigenous nuclear technology capability

GUIDING VALUES

Always adhere to the highest ethical standards and put good of students first Value excellence in research and foster innovation and creativity Recognize importance of science for the development of the society.

VISION

To provide an academic framework for integrating basic research wih technology development To encourage inter-disciplinary research To nurture an environment for attracting high quality manpower in the sciences including engineering sciences to take up a career in nuclear science, technology and related areas.

OBJECTIVES

The Institutional structure is designed to meet the overall intended objectives and being the distributed structure with the unitary system, all key members of the CIs/ OCC and faculty are represented fairly across various bodies of the Institute. This is given in the following illustration.

अणुविद्या

HBNI NEWSLETTER

DECEMBER 2019

150 YEARS OF CELEBRATING THE MAHATMA

अणुविद्या

The core mandate of HBNI is education in the domain of nuclear science and technology. The name of the newsletter "अणुविद्या" reflects this mandate.

Council of Management

Shri K. N. Vyas, Secretary DAE & Chairman, AEC	Chairman
Prof. P. R. Vasudeva Rao, Vice Chancellor	Member
Smt. Sudha Krishnan, Member (Finance), AEC	Member
Prof. A. K. Mohanty, Director, BARC	Member
Prof. R. A. Badwe, Director, TMC	Member
Prof. Sudhakar Panda, Director, NISER &IoP	Member
Prof. Surendra Prasad, Chairman NBA & Former Director, IIT Delhi	Member
Prof. Mustansir Barma, Professor Emeritus TIFR Centre for Inter-Disciplinary Sciences, Hyderabad	Member
Sri S. S. Sandhu, IAS, Additional Secretary, Department of Higher Education, MHRD, New Delhi	Member
Prof. P. D. Naik, Dean, HBNI	Member
Dr. B. Chandrasekar, Registrar	Secretary

Planning & Monitoring Board

Prof. P.R. Vasudeva Rao, Vice Chancellor	Chairman
Prof. A.K. Mohanty, Director, BARC	Member
Prof. P.D. Naik, Dean, HBNI	Member
Prof. S.K. Joshi, JNCASR Vikram Sarabhai Professor, NPL	Member
Prof. D. Kanjilal, Director, IUAC	Member
Prof. S. Ramakrishnan, Sr. Professor, TIFR	Member
Prof. R.B. Grover, Professor Emeritus, HBNI	Member
Prof. G. Amarendra, IGCAR	Member
Prof. S. Chaturvedi, Director, IPR	Member
Dr. B. Chandrasekar, Registrar	Secretary

Academic Council

Prof. P.R. Vasudeva Rao, Vice Chancellor	Chairman
Prof. A. K. Mohanty, Director, BARC	Member
Prof. A. K. Bhaduri, Director, IGCAR	Member
Prof. Indranil Manna, IIT Kharagpur	Member
Prof. Kannan N. Iyer, IIT Bombay	Member
Prof. E.D. Jemmis, IISc, Bangalore	Member
Prof. P.D. Naik, Dean, HBNI	Member
Dr. R.A. Badwe, Director, TMC	Member
Prof. D. Das, Director, RRCAT	Member
Prof. Sudhakar Panda, Director, NISER &IoP	Member
Prof. Pinaki Majumdar, Director, HRI	Member
Prof. V. Arvind, Director, IMSc	Member
Prof. Gautam Bhattacharyya, Director, SINP	Member
Prof. Shashank Chaturvedi, Director, IPR	Member
Prof. Shishir Deshpande, Director, ITER-IPR	Member
Dr. SumitSom, Director, VECC	Member
Prof. B. Venkatraman, IGCAR	Member
Prof. P.K. Pujari, BARC	Member
Prof. R. B. Grover, Convenor, BoS (Applied Systems Analysis)	Member
Prof. G Amarendra/ Prof. S.M. Yusuf, Convenor, BoS (Physical Sciences)	Member
Prof. A. P. Tiwari, Convenor, BoS (Engineering Sciences)	Member
Prof. S. V. Chiplunkar, Convenor, BoS (Life Sciences)	Member
Prof. B. Ramakrishnan, Convenor, BoS (Mathematical Sciences)	Member
Prof. B.S. Banavali, Convenor, BoS (Medical & Health Sciences)	Member
Prof. H. Pal,Convenor, BoS (Chemical Sciences)	Member
Prof. S. Panda, Convenor, BoS (Integrated Masters Programme)	Member
Dr. B. Chandrasekar, Registrar	Secretary

होमी भाभा राष्ट्रीय संस्थान
HOMI BHABHA NATIONAL INSTITUTE

प्रो. पी.आर. वासुदेव राव
कुलपति
Prof. P.R. Vasudeva Rao
Vice-Chancellor

150 YEARS OF CELEBRATING THE MAHATMA

होमी भाभा राष्ट्रीय संस्थान
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FROM THE VICE CHANCELLOR's DESK

I am very happy to present the second issue of the HBNI Newsletter, AnuVidya. The Foundation Day of HBNI, celebrated on 3rd June 2019, received excellent response from students, faculty as well as alumni. A report on this event appears in this newsletter. The time period since the Foundation Day celebration in June 2019 has seen many developments in HBNI, and in particular, the organization of unique courses of high value, the Short Course on Severe Accident Phenomenology, and the Certificate course on Nuclear Law. These courses also saw participation across CIs, through videoconferencing, a new element introduced this year with the commissioning of the videoconferencing system. More such courses are in the offing, in the coming year.

The academic programs in HBNI have continued to make good progress, and two new courses with focus on skill development have been introduced in the last six months – MSc (Hospital Radiopharmacy) and MSc (Nuclear Medicine and Molecular Imaging Technology). These are unique additions to the basket of courses offered by HBNI and promise to add a significant value to the country's human resources. The publications of HBNI faculty and students have continued to make a global impact – Nature Index 2019 has placed HBNI at the 16th place among the world's youngest Universities, based on publications in 82 high impact journals.

Other projects such as preparation of English-Hindi and English-Tamil glossary of nuclear terms, and writing of text books on important topics in nuclear science and engineering are making steady progress, and we hope that these efforts will reach their logical end in the coming year.

We have continued to tweak the academic processes in order to facilitate students. The enrolment for PhD programs have now been made online, not only to speed up enrolment process, but also to enhance the accuracy of HBNI database. This year, so far, around 60 students have availed foreign travel assistance to participate in International Conferences.

This issue of AnuVidya carries, in addition to regular features, a reprint of an article by Prof. Grover that appeared in Current Science. This article brings out succinctly, the motivation behind setting up HBNI, and the unique features and achievements of our academic programs. We are thankful to Current Science and to Prof. Grover, for the permission to carry this article.

I would like to specially acknowledge the efforts put in by Dr.(Mrs). Anshu Singhal, BARC in putting together this issue, and to Mr. Bhushan Chavan, BARC in designing the print version.

I take this opportunity to wish all our readers, and particularly the students, faculty and functionaries of HBNI, a Happy New Year 2020 !

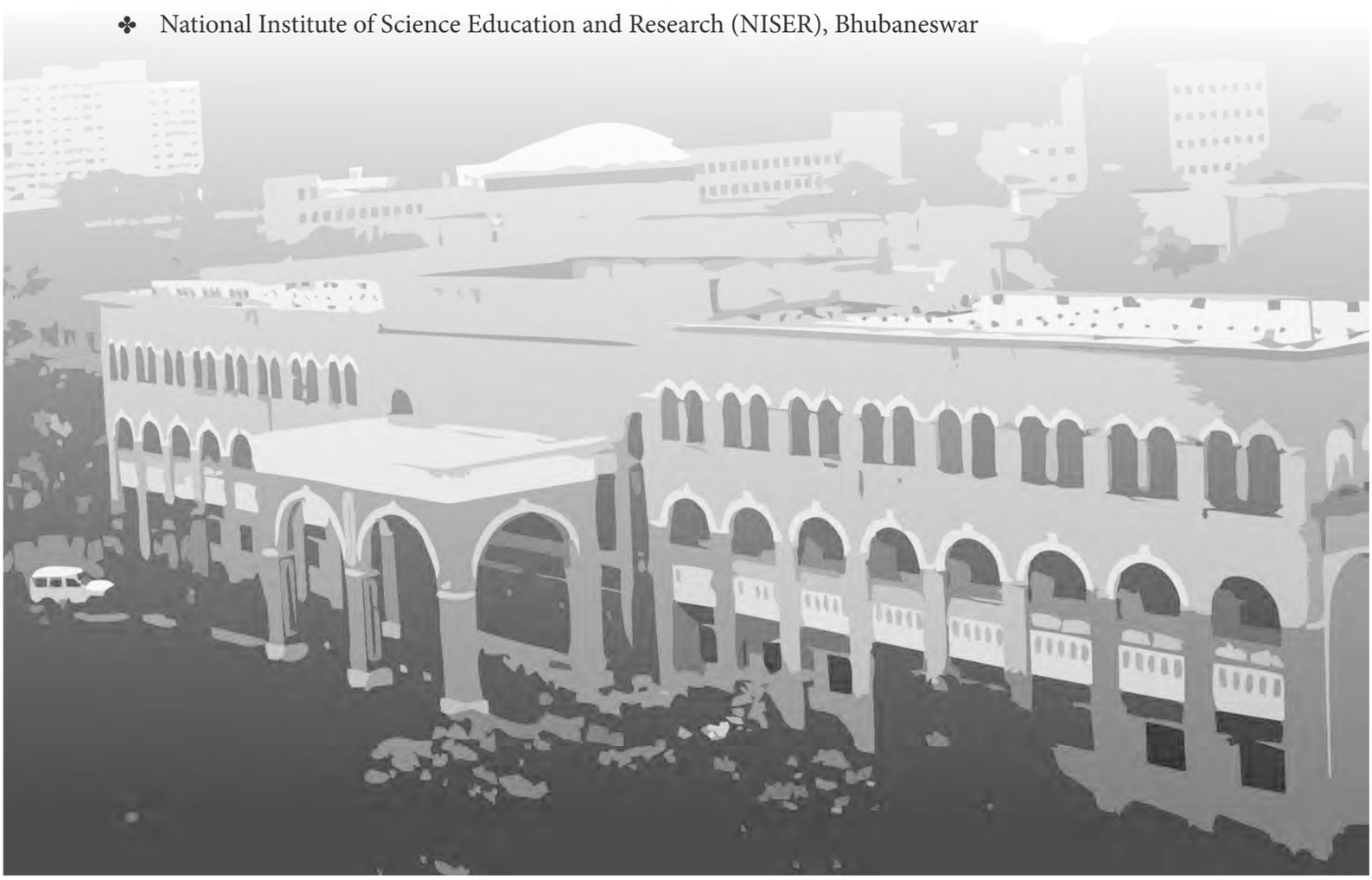
(P.R. Vasudeva Rao)

ABOUT HBNI

The HBNI brings together ten premier DAE institutions established as Research and Development Centers and grant-in-aid autonomous centers as Constituent Institutions, under a single research driven framework. NISER, Bhubaneswar, set up in 2006,is an Off Campus Centre (OCC) of HBNI.

The following are the institutions under HBNI academic research framework:

- Bhabha Atomic Research Centre (BARC), Mumbai
- Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam
- Raja Ramanna Centre for Advanced Technology (RRCAT), Indore
- Variable Energy Cyclotron Centre (VECC), Kolkata
- Saha Institute of Nuclear Physics (SINP), Kolkata
- Institute for Plasma Research (IPR), Gandhinagar
- Institute of Physics (IOP), Bhubaneswar
- Harish-Chandra Research Institute (HRI), Allahabad
- Institute of Mathematical Sciences (IMSc), Chennai, and
- Tata Memorial Centre (TMC), Mumbai.
- National Institute of Science Education and Research (NISER), Bhubaneswar



- Established in 2005 as a Deemed-to-be University under section 3 of the UGC (University Grants Commission) act1956.
- Recognised as Grant-in-aidInstitution of Department of Atomic Energy in 2014.
- Accredited as Grade A institution by National Assessment and Accreditation Council (NAAC).
- HBNI provides state of art research infrastructure including mega research facilities.
- Challenging research programmes
- Internationally renowned research guides.
- All academic programs duly approved by statutory bodies.
- DAE Fellowships on par with UGC guidelines or higher.
- Foreign Travel Assistance to doctoral students for participation in International Conference, Symposia, Scientific meetings
- Placed 17th among the Universities in India in NIRF 2019 ranking by Ministry of Human Resource Development, Govt. of India.
- Placed in the category of institutions accorded the highest level of autonomy by UGC, based on its NAAC ranking in 2018.
- Placed in the sixth position among Indian academic institutions by Nature Index 2019, with respect to publications in 82 selected high impact Journals during 2018.

HBNI has entered into Memorandum of Understanding with the following Institutes:

- Chennai Mathematical Institute, Chennai
- Indian Institute of Science, Bangalore
- Indian Institute of Technology, Kharagpur
- Indian Institute of Technology, Kanpur
- Indian Institute of Technology, Madras
- Indian Institute of Technology, Mumbai
- Institute of Chemical Technology, Mumbai
- Jadavpur University, Kolkata
- Jawaharlal Nehru University, New Delhi
- Panjab University, Chandigarh
- Tata Institute of Fundamental Research, Mumbai
- The Commissariat a l'energie atomique et aux energies alternatives, France

ACADEMIC PROGRAMMES OF HBNI

HBNI offers a range of academic programs in chemical sciences, engineering sciences, health sciences, life sciences, mathematical sciences and physical sciences. It also has a program in Applied Systems Analysis. All institutions, except NISER, conduct program for which entry level qualification is a Bachelor's degree. NISER admits Higher Secondary passed students for its five years Integrated M.Sc program.

Ph.D. programs are offered in varied disciplines such as Chemical Sciences, Engineering Sciences, Life Sciences, Mathematical Sciences, Medical and Health Sciences, Physical Sciences and Applied Systems Analysis is offered. HRI and IMSc also offer an integrated Ph.D. program where students study for M.Sc. followed by Ph.D.

M.Tech. in Engineering Sciences and M.Phil. in Physical Sciences, Chemical Sciences, Mathematical Sciences and Life Sciences are also offered. These programs consist of one year of course work and one year of project work. The course work is offered at all campuses of BARC Training School and IPR Training School. Project work is offered at BARC, IGCAR, RRCAT, VECC, IPR and units of DAE. Those who are not able to pursue or are not interested in pursuing a project/research work have the option to get a post graduate diploma in lieu of M.Tech. or M.Phil. degree.

M.Sc. (Engg) program has more emphasis on research content as compared to M.Tech. The duration of the project work under this program is one and a half year, while the duration of the course work is up to one year. This program is offered at BARC, IGCAR, VECC, RRCAT and IPR.

Integrated M.Sc of five-years duration is offered at NISER. M.Sc. of two-year duration is offered at HRI.

Super Specialty Courses offered in Health Sciences at TMC include :

- Doctor of Medicine (DM) in Medical Oncology, Pediatric Oncology, Gastroenterology, Critical Care, Oncopathology and Interventional Radiology
- Master of Chirurgiae (MCh) in Surgical Oncology, Gynecological Oncology, Plastic Surgery & Reconstructive Surgery, Head & Neck Oncology

Two year Certified Fellowship Programme in Medical and Health Sciences is offered at TMC.This post MD fellowship program is offered with specialization in Orthopedic Oncology, Breast Oncology, Thoracic Oncology, Uro Oncology, Interventional Oncology, Surgical Pathology, Haemato Pathology, Dental & Prosthetic Surgery, Preventive Oncology, Infectious Diseases & HIV Medicine, Gastrointestinal Oncology, Pulmonary Oncology, Molecular Haemato Oncology, Oral Oncology with Reconstructive Surgery.

Graduate Courses in Medical and Health Sciences offered at TMC & Radiation Medicine Centre* of BARC include:

- MD (Pathology, Anesthesia, Radio-diagnosis, Radiation Oncology, Microbiology, Nuclear Medicine*, Palliative Medicine, Immuno-Hematology & Transfusion Medicine)
- M.Sc. (Nursing) and M.Sc. (Clinical research) are offered at TMC.
- M.Sc. (Public Health in Epidemiology) and M.Sc. (Occupational Therapy in Oncology) are the new programs offered at TMC.
- PG Diploma in Fusion Imaging Technology (DFIT) is offered at TMC.

Following PG Diploma Courses are offered at BARC

- Diploma in radiological Physics (DipRP)
- Diploma in Medical Radio Isotope Techniques (DMRIT)
- Diploma in Nuclear Science and Engineering (DipNSE)

In addition, the TMC also offers a two-year Certified Fellowship Program in 21 different areas related to Oncology.Most of the Ph.D. programs are multi-disciplinary in nature having guides and co-guides from different branches of science and engineering.

Nine hundred and six students were admitted in different programs during 2018-19, out of which 383 students are for PhD program. HBNI has awarded 231 Ph.D., 176 M.Tech., 28 M.Sc. (Engg), 63 M.Sc., 5 M.Sc.(Nursing), 10 M.Sc.(Clinical Research), 110 post graduate & super speciality medical degrees with specializations in Oncology, and 38 PG diplomas, which includes 25 in DipRP, 10 in DFIT and 3 in DMRIT during this period.

EVENTS UPDATES

Foundation Day Celebration

The Foundation Day of Homi Bhabha National Institute was celebrated at the DAE Convention Center inAnushaktinagar, Mumbai on June 3, 2019. Chairman, AICTE, Prof. Anil Sahasrabudhe was the ChiefGuest for the occasion. Secretary, Department of Atomic Energy (DAE), Chairman, Atomic EnergyCommission and Chairman, Council of Management, Shri K. N. Vyas presided over the function. Chancellor, HBNI, Prof. S.Banerjee, functionaries of HBNI at various CIs/OCC and Central Office, and a large number of faculty, alumni and students of HBNI participated in the function.

Prof. P.D.Naik, Dean, HBNI welcomed the gathering. Prof. Vasudeva Rao also presented the annual report of HBNI for the period 2018-19. He highlighted the progress of HBNI in various domains, and described the efforts taken to streamline various procedures and make them student-friendly, at the same time ensuring robustness of the academic processes.

Prof. Anil Sahasrabudhe distributed degree certificates and also presented awards to 33 Outstanding students of Ph.D, M.tech., M.Sc(Engg), MD, DM and MCh programs. He delivered an address on the topic “Challenges and Opportunities in Technical Education”. He said that the statistics on employability of the graduate engineers is a matter of concern. To address this, we need to create generic and improved skillsets, by regularly revising the curriculum, addressing students' engagement in the classrooms and the hands-on experience that can be provided to them, and by teaching students various aspects such as team work and time management. At the same time, industry also needs to realize that graduates would need

Dignitaries on the Dais

Professor Sahasrabudhe delivering his address

Dr.Kakodkar delivering J.B. Joshi Research Foundation Endowment Lecture

some time and training within the job to become fully functional. He advised that every educational institution should aim to give a unique learning experience that could make the student proud of the institution. If this is done, our Universities will be able to attract bright minds not only from within the country but also from abroad.

Member, Atomic Energy Commission and Chairman, Rajiv Gandhi S&T Commission, Dr. Anil Kakodkar delivered the J. B. Joshi Research Foundation Endowment Lecture on the topic "Reshaping research culture – Genesis of Homi Bhabha National Institute". He said that DAE has had a good ecosystem which has enabled its technology to be translated into industry efficiently and there is a need to build a cadre of researchers and developers who can network and translate the latest in scientific research into new technology ahead of others; he expressed the hope that HBNI would facilitate this. He recalled that HBNI was created to provide an academic environment for the DAE's mission oriented activities, and provide an academic connectivity between its R & D units and Grant-in-aid institutes.

Delivering the Presidential Address, Secretary, DAE, Chairman, Atomic Energy Commission and Chairman, Council of Management, HBNI, Shri K. N. Vyas said that the research programs in HBNI are offered by R&D institutes at various locations; these institutes provide excellent facilities and immense opportunities for research. He expressed happiness that the research standards being maintained by HBNI are very high; he told the students that they can make significant improvements to their thesis by being systematic in their research. He expressed the hope that the institute will continue to grow in the years to come.

Shri K.N. Vyas giving Presidential Address

Prof. S. Banerjee, Chancellor, delivering his address

Chancellor, HBNI, Prof. Srikumar Banerjee said that HBNI is an umbrella organization which cuts across institutional boundaries and enables researchers to work in various diverse areas. He said that the institute is well-suited to promote both individual research excellence and group achievement. He said that one of the objectives with which HBNI was created was to provide lifetime learning opportunities for the DAE researchers to enable them to remain at the forefront. He also emphasized the importance of mobility of researchers across the institutions, and pointed out that HBNI provides such opportunities to its students.

The first issue of the AnuVidya Newsletter was released on the occasion. The Newsletter will be published on a bi-annual basis, to start with. Besides providing news about the progress of the academic programs at HBNI, the newsletter also aims to highlight the honours and recognition received by our faculty and students, events organized at our CIs/OCC as well as at the Central Office AnuVidya will also provide a flavor of the artistic talents of our students and faculty.

Dr. B. Chandrasekar, Registrar, HBNI, proposed a vote of thanks.

Following the formal program, a colourful cultural program was presented by students of HBNI.

Cultural program on the occasion of HBNI Foundation Day Celebration by students

Inaugural function of Dr. Vikram Sarabhai Birth Centenary Program

2019 marks the birth centenary year of Dr. Vikram Sarabhai, the prime architect of India's Space Programme, who also succeeded Dr.Homi Bhabha as Chairman of Atomic Energy Commission in 1966.

The Department of Atomic Energy (DAE) has chalked out a year-long birth centenary program, which will witness a range of activities at various units of DAE pan-India, highlighting the scientific achievements and institution building efforts of Dr. Sarabhai.

The inaugural event of the program was held in Bhabha Atomic Research Centre (BARC), Mumbai, during Oct 17-18, 2019, with the participation from Indian Space Research Organisation (ISRO). Dr. Kasturirangan, former chairman, ISRO, and Shri. Surendra Sharma, former chief executive, Heavy Water Board graced the occasion as the Chief Guest and the Guest of Honour.

The valedictory function of Dr. Vikram Sarabhai Birth Centenary Program will be held at Vikram Sarabhai Space Centre in Thiruvananthapuram jointly by DAE and ISRO on August 12, 2020.

Shri K.N. Vyas, Chairman, AEC and Secretary, DAE, inaugurating Dr. Vikram Sarabhai Birth CentenaryProgram
(To his left: Dr. Kasturirangan, Former Chairman, ISRO and Shri Surendra Sharma, former Chief Executive, Heavy Water Board)

Dignitaries releasing a Souvenir on the Life, Career and Professional achievements of Dr. VikramSarabhai during the inaugural function

Teachers' Day Celebration

Teachers' Day was celebrated at the Central Office on 5th Sep. 2019. Prof. S. Banerjee, Chancellor, HBNI graced the occasion as the Chief Guest. Emeritus Professors, Prof. R.B. Grover and Prof. J.B. Joshi participated in the event besides other HBNI functionaries.

Prof. P.R. Vasudeva Rao, Vice Chancellor, HBNI, welcomed the gathering. Prof. J.B. Joshi recalled that he had been a teacher for over four decades, and the teaching experience had truly enriched him. He said that he had greatly enjoyed his association with DAE, which provided him opportunities to study a number of challenging problems with the help of students. Prof. R.B. Grover recalled the pioneering contributions made by Sarvepalli Radhakrishnan to the education system in the country.

Speaking on the occasion, Prof. Banerjee emphasized the need for continuously updating the curriculum towards empowering the students and young researchers. He also stressed the need for further promoting academic and research collaboration between grant-in-aid institutes and R & D units of DAE, and synergizing the basic research carried out in the grant-in-aid `institutions with the technology development goals of the R & D units. Responding to this, Vice Chancellor informed the gathering about the MSc. (Medical and Radiation Physics) program proposed to be started at NISER and said that the planning and implementation of the program will have active participation from BARC.

Dr. B. Chandrasekar, Registrar proposed a vote of thanks.

Teachers' Day celebration at HBNI Central Office on 5th Sep. 2019

Short course on Severe Accident Phenomenology (SAP)

INSTN, France – HBNI, India, 09 Sep-14 Sep 2019

HBNI entered into a Memorandum of Understanding (MoU) with INSTN, France on 18th of September, 2018. As part of the collaboration, it was decided that a joint course would be organized on Severe Accident Phenomenology (SAP). This course was to focus on dissemination of the knowledge gained on Severe Accidents in the last two decades to Masters-PhD students and young professionals. The programme covered sever accident phenomenology, progression and mitigation in current water cooled reactors (LWR and HWR) of generation II and III. A special focus was given on the Fukushima-Daiichi severe accident. The SAP course was organized from 9th September to 14th September, 2019 at CEA-Cadarache, France. Lectures were delivered by international experts from major nuclear institutions, industries and universities. Five lecturers from India delivered their lectures from HBNI, Mumbai through video-conference. The lectures dealt with the reaction of reactor systems to various SA scenarios. The course also included background lectures on Nuclear Power Plant safety, SA scenarios and the event leading to the early and late failure of containment. The course was attended by large number of international participants, from seventeen countries, at Cadarache, France. On the recommendation of HBNI, three young professionals from BARC, NPCIL and AERB were nominated for attending the program at

Inauguration Function at HBNI, Mumbai, India

Lecture in Progress at Cadarache, France

EVENTS UPDATES

Lecture in Progress at HBNI Central Office

Group photograph after feedback and conclusion session at HBNI Central Office, Mumbai

Cadarache. Parallelly, 43 Indian professionals also participated in this course at HBNI Central Office in Mumbai and at IGCAR, Kalpakkam through video-conference. In India, the programme was inaugurated by Shri Atul Bhandakkar, Executive Director (Engineering), NPCIL.Vice-Chancellor, HBNI distributed certificates to the local participants after feedback and conclusion session.

Certificate Course on Nuclear Law:

A certificate course on Nuclear Law was organized by HBNI for middle level professionals in various units of DAE such as BARC, AERB, NPCIL, IGCAR, NFC and BRIT. Prof. R.B. Grover, Emeritus Professor, HBNI & former Director, SPG, and Dr. K.L. Ramakumar, former Head, NCPW, DAE were the course Directors. The course consisted of 44 lectures, delivered by Prof. Grover, Prof. Ramakumar and several other serving as well as retired experts from DAE units, law firms and insurance firms. The topics covered by the course included an overview of various international treaties, Indian laws covering various aspects such as liability and insurance, nuclear security and some elements of nuclear safety. A total of 44 colleagues from the DAE units participated in the course, of which 20 colleagues from IGCAR and NFC participated through video conference mode. The program of the course also

EVENTS UPDATES

included assignments and quiz. The course program was inaugurated by Prof. A.K. Mohanty, Director, BARC, on 19th August, 2019. The course provided a good exposure to the participants about various aspects of nuclear law, and received enthusiastic response from the participants. Participant certificates were distributed by Shri K. N. Vyas, Chairman, Council of Management, HBNI and Secretary, DAE, on 23rd November 2019.

Inauguration of the Certificate Course on Nuclear Law by Prof. A.K.Mohanty, Director, BARC

A view of the participants during inauguration

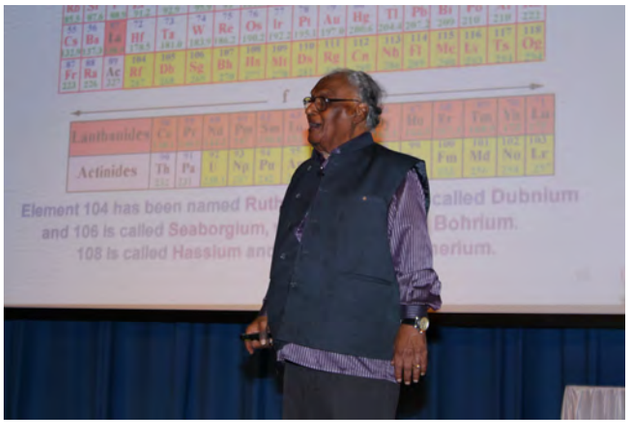
Dr.K.L.Ramakumar delivering a lecture. Participants gathered at NFC & IGCAR can be seen in the television screens.

DAE Theme Meeting Commemorating "150 Glorious years of Periodic Table"

UN General Assembly had proclaimed the year 2019 as the International Year of the Periodic Table of Chemical Elements (IYPT) to celebrate the 150th anniversary of the discovery of the Periodic System by Dmitri Mendeleev in 1869, which is undoubtedly one of the most important and influential achievements in modern science. In association with BARC and the Atomic Energy Education Society (AEES), HBNI organized a half-day Theme Meeting commemorating the International Year of the Periodic Table (IYPT-2019) at DAE Convention Centre, Anushakti Nagar on November 27, 2019. The programme was attended by more 400 students from Atomic Energy Central School and 250 delegates from BARC, HBNI and various colleges in Mumbai. Prof. C.N.R.Rao, Linus Pauling Professor and Honorary President, Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR) gave the keynote address. and Dr. (Mrs). Indumati Rao, Education Technology Unit, JNCASR as well as Prof. G. Mugesh, Department of Inorganic and Physical Chemistry, IISc, Bengaluru delivered guest lectures.

In the inaugural session, Prof. P.R. Vasudeva Rao, Vice-Chancellor, HBNI welcomed the gathering and the invited speakers. In his address, Prof. A.K.Mohany, Director, BARC described the formulation of periodic Table as a monumental event in the history of chemistry and emphasized its importance for other disciplines of science including physics, biology and

Inauguration function of IYPT-2019



Prof. C.N.R. Rao delivering a keynote lecture

Prof. C.N.R. Rao with school students

Dr. (Mrs.) Indumati Rao delivering a lecture

Prof. G. Mugesh delivering a lecture

हिन्दी दिवस समारोह

हिन्दी दिवस के अवसर पर होमी भाभा परिषद कक्ष मे दिनांक 16 सितंम्बर 2019 को प्रात: 11:30 बजे एक समारोह का आयोजन किया गया। इस समारोह के पूर्व 13 सितंम्बर को अंग्रेजी - हिन्दी अनुवाद प्रतियोगिता आयोजित की गई जिसमे संस्थान के 23 कर्मचारियों ने भाग लिया।

हिन्दी दिवससमारोह मेंप्रो भूपेन्द्र तोमर (संस्थान चेअर प्रोफेसर) ने स्वागत भाषण दिया व अतिथियों का स्वागत किया। तत्पश्चात नई दिल्ली स्थित मानव संसाधन विकास मंत्रालय के वैज्ञानिक एवम् तकनीकी शब्दावली आयोग के सह निदेशक श्री शिवकुमार चौधरी ने हिन्दी के विकास मे वैज्ञानिक एवम् तकनीकी शब्दावली का महत्त्व पर अपनी वार्ता प्रस्तुत की। प्रो गौतम कुमार डे पूर्व निदेशक पदार्थ वर्ग भाभा परमाणु अनुसंधान केन्द्र व राजा रामन्ना फेलो ने परमाणु ऊर्जा के लिये नये पदार्थो का विकास - कुछ नये आयाम् पर वार्ता प्रस्तुत की। संस्थान के कुलपति महोदय ने समारोह में अग्रेजी -हिन्दी अनुवाद प्रतियोगिता मे सर्वाधिक अंक प्राप्त करने वाले कर्मचारियों को पुरस्कार वितरण किये। कुलपति ने अपने भाषण में हिन्दी भाषा के प्रचार एवम् प्रसार के महत्त्व पर जोर दिया तथा कुछ कवितायें भी प्रस्तुत की। डॉ तोमर ने अन्त मे धन्यवाद प्रस्ताव प्रस्तुत किया। कार्यक्रम में संस्थान के सभी कर्मचारियों ने भाग लिया।

परिषद कक्ष में हिन्दी दिवस समारोह में भाग लेते HBNI के सदस्य।

श्री शिवकुमार चौधरी अपनी वार्ता प्रस्तुत करते हुये।

डॉ गौतम कुमार डे अपनी वार्ता प्रस्तुत करते हुये।

श्री शिवकुमार चौधरी को स्मृति चिन्ह भेंट करते हुये कुलपति प्रो वासुदेवराव।

डॉ गौतम कुमार डे को स्मृति चिन्ह भेंट करते हुये कुलपति प्रो वासुदेवराव।

अंग्रेजी हिन्दी अनुवाद प्रतियोगिता में विजेताओं में से एक सदस्य कुलपति महोदय से पुरस्कार ग्रहण करते हुये।

Founder's Day at BARC

The 110thbirth anniversary of Dr. Homi Jehangir Bhabha was celebrated as Founder's Day on 30th October 2019 at BARC. The dignitaries present on the occasion included Shri A.N. Prasad, Former Director of the Bhabha Atomic Research Centre and Dr. J.P. Mittal, Distinguished Professor & Chairman, Academic Board UM-DAE, CEBS.

Dr. A.K. Mohanty, Director BARC welcomed the large gathering of DAE family. In his speech, he highlighted the recent achievements of BARC related to agriculture, industry and medicine. In his address, Sri K. N. Vyas, Chairman, Atomic Energy Commission and Secretary, DAE informed that in the health care sector, development of cost effective drugs for cancer care has been a priority for DAE and that 21 numbers of radiopharmaceuticals for diagnosis and therapy and radionuclide generators have been developed in the recent past. He further stated that extraction of clinical grade Yttrium-90 in 90Y-Acetate form from high level waste trials for patient care has been started.He added that RRCAT has come up with medical devices like 'TuBerculoScope' – a low cost, compact and portable optical device for rapid detection of TB and 'OncoDiagnoscope' – a compact and portable system for non-invasive detection of (pre)cancerous lesions in oral cavities. These technologies are ready for transfer to the local industry. Dr. J.P. Mittal, Distinguished Professor & Chairman, Academic Board UM-DAE, CEBS, delivered a talk on the topic "A Tryst with Radiation Research".

Dignitaries occupying the Dais

Founder's Day address by Chairman, AEC & Secretary, DAE

The DAE (Excellence in Science, Engineering & Technology) Awards for the year 2018 were awarded at the hands of Shri A.N. Prasad, Former Director of the Bhabha Atomic Research Centre. A few lines about Prasad's talk..

The function was attended by a large number of scientists, engineers and DAE family members.

Chief Guest Shri A.N. Prasad delivering his address

Dr. J.P. Mittal delivering special lecture his address

Mini-marathon on theme"No Water No Life" at RRCAT

HBNI, RRCAT organized a mini-marathon on 21st September, 2019 in RRCAT premises on the theme "No Water. No Life" to sensitize the Ph.D. Scholars, project trainees, CISF personnel, RRCAT employees and their dependents about the importance of water for life.

Shri Debashis Das, Director, RRCAT was the Chief Guest and Smt. Sujayita Daswas the Guest of Honour for the event. In his inaugural speech, Shri Das reiterated the importance of water in our lives and its conservation for posterity. He praised the efforts of HBNI programme at RRCAT in bringing Ph.D. and M.Tech. scholars, CISF security personnel, RRCAT employee and their dependents together on such thematic and important event. There were total 130 participants including 55 CISF personnel. The prizes were given in various categories including Ph. D. and M. Tech. students, RRCAT Employees, CISF (Women), and CISF (Men). These prizes were distributed on HBNI Scholars' Day during the cultural evening.

EVENTS AT OTHER CIs/OCC

Participants of mini-marathon "No Water No Life".

HBNI Scholars' Day celebrated at RRCAT

HBNI Scholars' day was organized on 26th September under the guidance of HBNI functionaries at RRCAT and the Director, RRCAT. It was conducted in two sessions. In the

Prof. Somak Raychaudhury, Director, IUCAA, Pune inaugurating the poster session of HBNI Scholars' Day, 2019 and glimpses of cultural programmes "Spectrum" organized by the students on Scholars' Day

Prof. K. VijayRaghvan, PSA to GoI addressing on the occasion

International Yoga day at VECC, 21st June 2019

Celebration of National Technology Day at VECC Kolkata on July 2, 2019.

Prof. S. Panda , Director NISER adddressing the gathering on NISER Foundation Day, September 6, 2019

Visit by Shri. K. N. Vyas, Chairman, AEC, to Facilitation Centre for Industrial Plasma Technologies, IPR

scientific session, the Chief Guest of the function, Dr. SomakRaychaudhury, Director, IUCAA, Pune delivered a talk titled "Einstein's Legacy in our time; Cosmic Illusions & Gravitational Waves". It was followed by a poster session in which the Ph.D. Scholars displayed their recent research works through several posters. It provided an opportunity to the Ph.D. Scholars for an active interaction with the scientific community of RRCAT and helped the scholars to explore avenues for collaborative work with other groups.

In the evening students organized a colourful cultural programme titled "Spectrum". The cultural evening was a bouquet of colourful dance performances, melodious songs and a drama.

Yoga Day at IPR

International Day of Yoga, or commonly referred to as Yoga Day, is celebrated annually on 21 June since its inception in 2015. IPR celebrated this event on 21 June 2019 by organizing a yoga session in the lawns of IPR campus. Many of the IPR staff participated in the event where a yoga expert Mr. Vivek Sharam (Art of Living) conducted the session for the benefit of IPR staff.

Summer School Programme (SSP-2019) at IPR

The Summer School programme for the year 2019 was held at IPR from May 27- July 5, 2019. For this 6 week programme, 32 students of science (22) and engineering streams (10) were selected. The students first had a week of class room lectures on various domains of plasma physics and applications by IPR faculty, followed by a five week project work. The students' projects were evaluated based on the presentations made on their projects at the end of the School. As part of the programme, the students visited the ICRH facility of ITER-India laboratory located at the IPR campus. In the course of the school, the students also visited most of the labs in IPR, FCIPT, ITER-India and IPR extension labs at Gandhinagar. The SSP-2019 students were also taken for a leisure-cum-adventure trip to the Orsang Camp Resort located in Vadodara.

"Swachhta Hi Seva (SHS)" Campaign at IPR

"Swachhta Hi Seva (SHS)" Campaign was observed at IPR and its different campuses during 11th September to 2nd October 2019 with great zeal and enthusiasm. As part of this drive, IPR staff were motivated to clean their offices and laboratory spaces and also clear away plastic and other unwanted materials. All employees of IPR were effectively involved in mass cleaning activities during this campaign. Extensive drive was done for cleaning of all the offices, laboratories, canteens, guest houses, kitchens, and lavatories for the removal of unwanted items (plastic, paper, metal, non-metal, and different other waste). Various posters, banners, slogans were displayed on notice boards and in various other location of IPR, showing importance of cleanliness during this campaign. A seminar on "Swachhata Hi Seva (SHS) Campaign - 2019" was also conducted at IPR. Several action plans also have been undertaken to continue this Swachhta Hi Seva Campaign.

Sarabhai Centenary Exhibition

IPR coordinated the exhibition associated with the Centenary Celebrations of Dr. Vikram Sarabhai which was inaugurated at Ahmedabad on 12th Aug, 2019 at the Gujarat University Convention Centre. This event was jointly organized by DAE and ISRO and attended by dignitaries from both DAE and DOS. A one-day exhibition was also held to showcase the various technologies developed by both DAE and ISRO. IPR exhibited the plasma pyrolysis model at this event. Chairmen of both DAE and ISRO, invitees as well as students visited the exhibition.

Scientific Outreach by IPR

IPR participated in the "TARANG 2k19-Space Science Fest" held at the LD College of Engineering, Ahmedabad on at LDCE on 30th August, 2019. Ms. ChhayaChavda and Ms. Harsha Machchhar of Outreach Division delivered popular lectures on Plasma and its Applications at this event to graduate engineering students.

CONFERENCE UPDATES

Pressing for Progress 2019: An IPA National Conference towards Gender Equity in Physics

A conference towards gender Equity in Physics, Pressing for Progress was held at School of Physics, University of Hyderabad from 19th to 21st September, 2019 to bridge disciplinary divides and debate the long-standing question as to why there is a persistent gender gap in the physics profession in India. The conference was inaugurated by the Vice-President of the Indian Physics Association, and Head, Solid State Physics Division, BARC, Dr. S.M. Yusuf. The inter-disciplinary conference was primarily supported by the Department of Science and Technology, Government of India, with additional funding support from the Harish Chandra Research Institute, Allahabad, and the Institute of Mathematical Sciences, Chennai. The conference provided a common platform to physicists, educationists, social scientists and diversity experts to deliberate on different angles on promoting gender equality. The conference had three keynote physics talks including one on quantum information by Prof. Aditi De, the first woman Shanti Swarup Bhatnagar awardee in physics, from Harish Chandra Research Institute, constituent institute of HBNI. About thirty women physicists from all over the country presented talks on their research in four parallel physics sessions ranging from planetary physics to biophysics.An innovative component of the conference was the opportunity to participate in immersive, process-based workshops that were designed to build capabilities in understanding gender inequity.

Participants in the Conference "Pressing for Progress 2019"

Discussion meeting on extreme QCD matter

The first IMSc discussion meet was held at Institute of Mathematical Sciences, Chennai during 16-21 September 2019. The meet had pedagogic lectures by senior scientists on the current state of the art, open problems and challenges in the area of hot and dense QCD matter. There were mini-review talks by young scientists and graduate students also.

International Conference on Nanostructuring by Ion Beams (ICNIB-2019)

An International Conference on Nanostructuring by Ion Beams (ICNIB-2019) was organized by IGCAR during Nov 6-8, 2019 at Kalpakkam in association with Board of Research in Nuclear Sciences (BRNS), Ion Beam Society of India (IBSI), Inter-University Accelerator Center (IUAC) and Materials Research Society of India (MRSI). This biennial international conference is held every alternate years to bring together physicists and accelerator materials scientists along with the research students. The 5th international conference washeld at IGCAR for the first time; ten international delegates and about hundred delegates from national research institutes and universities deliberated on various topics using accelerated ions: applications of ion beams for studying radiation damage and modifications in solids, ion-beam processing of novel compound phases and nanoscale precipitates, ripple formation. A pre-conference school was also arranged for two days to introduce the updated research subject to fresh doctoral students, during Nov 4-5, 2019.

Release of the Book of Abstracts of ICNIB- 2019on November 6, 2019.
(R to L) Dr. G. Amarendra, Chairman, ICNIB-2019, Prof. Avinash Chandra Pandey, Director, Inter-University Accelerator Center, New Delhi, Dr. B. K. Panigrahi, Chairman, ICNIB-2019 and Dr. C. David, Convener, ICNIB-2019.

In his welcome address, Dr. G. Amarendra, Director MSG & MMG, IGCAR stressed on the accelerator based research programme of simulating radiation damage in nuclear materials, being pursued at IGCAR. In his opening remarks, Dr. B. K. Panigrahi, Director, MC&MFCG & EIG, IGCAR presented a glimpse of past and current accelerator based research activities in IGCAR using low to medium energy ion accelerators. During the inaugural address, Prof. Avinash Chandra Pandey, Director, IUAC presented an overview of availability and uses of different accelerators present in India.

Vigyan Samagam @ Mumbai & Bengaluru

India's first mega science exhibition, "Vigyan Samagam" concluded its first leg at the Nehru Science Center, Mumbai on 7th July 2019. This 2-month exhibition was visited by over 1.5 lakh visitors during the two months. This exhibition will now move to the second leg at Visvesvaraya Industrial and Technological Museum, Bangalore (VITM) from 29th July to 29th September, 2019. During the 2 month programme at Mumbai, 35 scientists/engineers from ITER-India and IPR participated in this event for manning the ITER stall, delivering popular and technical talks at various programmes of the exhibition.

The "Vigyan Samagam" began its second leg on 29th July, at the Visvesvaraya Industrial and Technological Museum, Bangalore (VITM). The exhibition was inaugurated by Dr. Anil Kakodkar, Member AEC & Chairman RGSTC, Mumbai, along with Prof. V. S Ramamurthy, Emeritus professor, NIAS, Bengaluru. The ITER week was held from 20-24 August, 2019 at the VITM, Bangalore. In addition to popular talks, IPR and ITER-India exhibited interactive exhibits on plasma and its applications during the ITER week.

NEWS UPDATES

New Courses

The Radiation Medicine Centre (RMC) of Bhabha Atomic Research Centre, , has introduced two new courses, namely, (a) M.Sc. in Nuclear Medicine and Molecular Imaging Technology and (b) M.Sc. in Hospital Radiopharmacy, with an intake capacity of10 students per year for each course (5 non-sponsored and 5 sponsored), from the year 2019.The Institute has received the approval to initiate these courses following its review and deliberations at multiple levels at BARC as well as at HBNI. In the first year, the M.Sc. (Hospital Radiopharmacy) will have 5 seats which will be increased to 10 from the next year.

While the M.Sc. (Nuclear Medicine and Molecular Imaging Technology) is primarily the augmentation of the DMRIT course, the M.Sc. (Hospital Radiopharmacy)is a newly envisaged course which is intended to cater to the trained manpower requirement of the growing number of nuclear medicine centres in India.

With the evolution and rapid growth of radiopharmaceutical sciences, it is imperative that introduction of specific academic courses such as M.Sc. in Hospital radiopharmacy will be an absolute requirement; in order to develop and operate state-of-art nuclear medicine centres in the country. It is hoped that this new academic programme would help in developing and providing trained manpower (who will have hands-on training in all aspects of Medical Cyclotron operation & Hospital Radiopharmacy practices) to the Nuclear Medicine Departments of Hospitals and independent Centres of the country. The initiation of the two new M.Sc. courses also supports Department of Atomic Energy's mandate of Human Resource Development.

The Tata Memorial Centre Centre (TMC) has introduced two new courses, namely, (a) M.Sc. in Public Health in Epidemiology and (b) M.Sc. in Occupational Therapy in Oncology. In M.Sc. (Public Health in Epidemiology), the student will be exposed to Epidemiology, biostatistics, population science, health economics, social and behaviour science, human genetics, cancer registry etc and will be trained in conducting field intervention trials. In M.Sc. (Occupational Therapy in Oncology) course, the student will be exposed to basic surgical anatomy and physiology and various basic toolseffective for therapy and will learn various modalities that facilitate rehabilitation for physical and /psychological conditions following cancer.

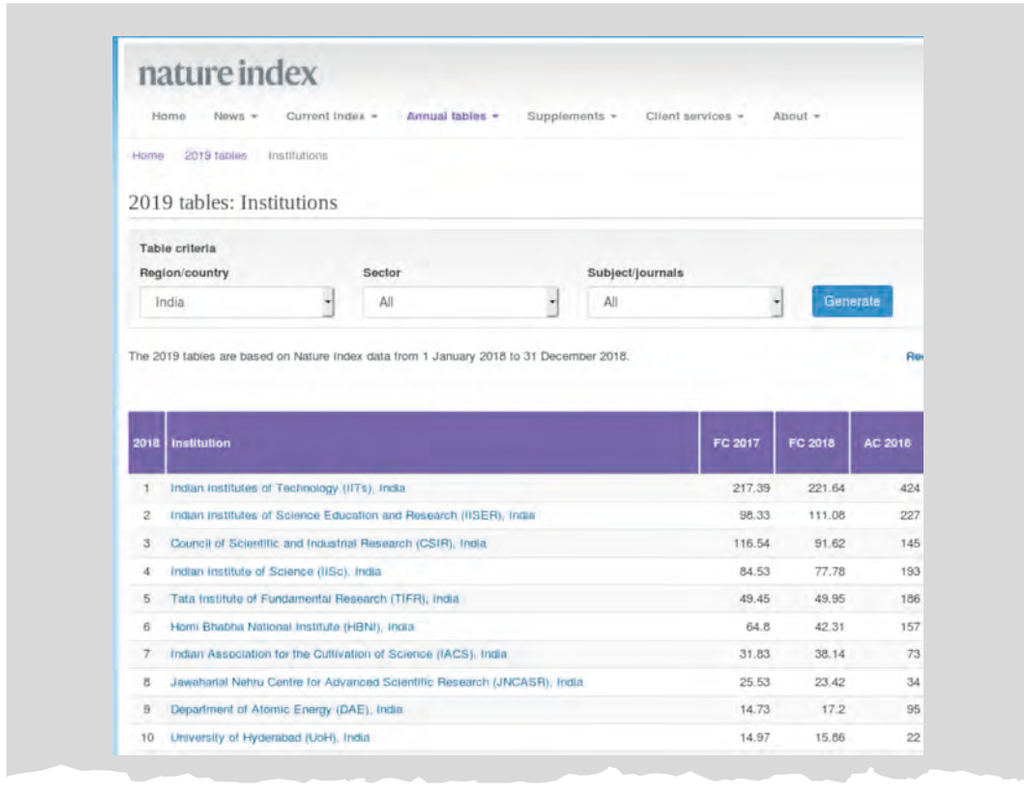
HBNI PUBLICATIONS

Nature Index 2019

The Nature Index is a database of author affiliation information collated from research articles published in an independently selected group of 82 high-quality science journals. The database is compiled by Nature Research. The Nature Index provides a close to real-time proxy of high-quality research output and collaboration at the institutional, national and regional level.

Each year, the Nature Index publishes tables based on counts of high-quality research outputs in the previous calendar yearcovering the natural sciences. With regard to 2018 data, HBNI stood second with regard to output in physical sciences and sixth with regard to output in all subjects among Indian academic institutions.

HBNI has also been recognized as one of the best performing "young universities (less than 50 years old)". In fact, HBNI is the top performer among Young Universities in India. On a global level, HBNI was placed at 16th position among Young Universities with regard to publications in all disciplines, whereas with regard to physical sciences, HBNI was placed at the tenth position.



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2019 tables: Institutions

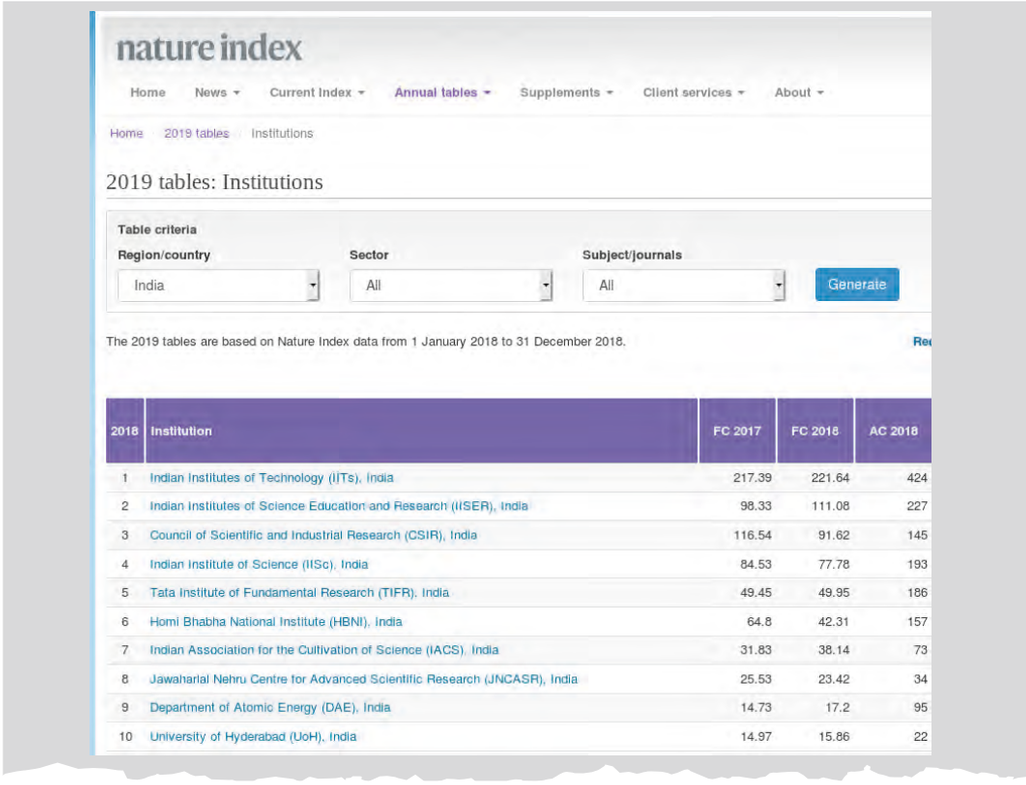
Table criteria

Region/country: India | Sector: All | Subject/journals: All | Generate

The 2019 tables are based on Nature Index data from 1 January 2018 to 31 December 2018.

2018	Institution	FC 2017	FC 2018	AC 2018
1	Indian Institutes of Technology (IITs), India	217.39	221.64	424
2	Indian Institutes of Science Education and Research (IISER), India	98.33	111.08	227
3	Council of Scientific and Industrial Research (CSIR), India	116.54	91.62	145
4	Indian Institute of Science (IISc), India	84.53	77.78	193
5	Tata Institute of Fundamental Research (TIFR), India	49.45	49.95	186
6	Homi Bhabha National Institute (HBNI), India	64.8	42.31	157
7	Indian Association for the Cultivation of Science (IACS), India	31.83	38.14	73
8	Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), India	25.53	23.42	34
9	Department of Atomic Energy (DAE), India	14.73	17.2	95
10	University of Hyderabad (UoH), India	14.97	15.86	22

HBNI PUBLICATIONS



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10	University of Hyderabad (UoH), India	14.97	15.86	22

Publications by students/faculty in our CIs/OCC

Discipline	2019*
Physical Sciences	663
Chemical Sciences	218
Engineering Sciences	84
Health Sciences	23
Life Sciences	70
Engineering Sciences & Physical Sciences	31
Mathematical Sciences	52
Chemical Sciences & Physical Sciences	38
Chemical Sciences & Engineering Sciences	8
Chemical Sciences & Life Sciences	7
Chemical Sciences & Engineering Sciences & Physical Sciences	1
Health Sciences & Life Sciences	5
Total	1200

REVIEWS OF MODERN PHYSICS, VOLUME 91, JANUARY–MARCH 2019

Colloquium: Superheavy elements: Oganesson and beyond

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(published 22 January 2019)

During the last decade, six new superheavy elements were added into the seventh period of the periodic table, with the approval of their names and symbols. This milestone was followed by proclaiming 2019 the International Year of the Periodic Table of Chemical Elements by the United Nations General Assembly. According to theory, due to their large atomic numbers, the new arrivals are expected to be qualitatively and quantitatively different from lighter species. The questions pertaining to superheavy atoms and nuclei are in the forefront of research in nuclear and atomic physics and chemistry. This Colloquium offers a broad perspective on the field and outlines future challenges.

DOI: 10.1103/RevModPhys.91.011001

Institute : VECC

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A Transparent Photonic Artificial Visual Cortex

Mohit Kumar, Tapobrata Som, and Joondong Kim**

Mimicking brain-like functionality with an electronic device is an essential step toward the design of future technologies including artificial visual and memory applications. Here, a proof-of-concept all-oxide-based (NiO/TiO_2) highly transparent (54%) heterostructure is proposed and demonstrated, which mimics the primitive functions of the visual cortex. Specifically, orientation selectivity and spatiotemporal processing similar to that of the visual cortex are demonstrated using direct optical stimuli under the self-biased condition due to photovoltaic effect, illustrating an energy-efficient approach for neuromorphic computing. The photocurrent of the device can be modulated from zero to 80 μA by simply rotating the slit by 90°. The device shows fast rise and fall times of 3 and 6 ms, respectively. Based on Kelvin probe force measurements, the observed results are attributed to a lateral photovoltaic effect. This highly transparent, self-biased, photonic triggered device paves the way for the advancement of energy-efficient neuromorphic computation.

depicted in **Figure 1**a.[8,9] The LGN cells subsequently forward this information to the visual cortex cells, which express a specific response to image edges or orientations.[2,8,10] Therefore, emulating the dynamic visual cortex with electronic devices is an essential step toward artificial visual processing, and has great importance for neuromorphic applications.

The pioneers Hubel and Wiesel experimentally demonstrated the functioning of visual perception and revealed that the output of the visual cortex cell is highly sensitive to the orientation of light bars.[11] For instance, the output of the visual cortex change from zero to maximum value by changing the orientation of the light slit, as is depicted in Figure 1b. For clearly

Institute :IOP, HBNI, Anushakti Nagar

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Robust Antiskyrmion Phase in Bulk Tetragonal Mn–Pt(Pd)–Sn Heusler System Probed by Magnetic Entropy Change and AC-Susceptibility Measurements

*Sk Jamaluddin, Subhendu K. Manna, Bimalesh Giri, P. V. Prakash Madduri, Stuart S. P. Parkin, and Ajaya K. Nayak**

Magnetic skyrmions, topologically protected chiral spin textures having potential applications in data storage, are stabilized in certain magnetic materials with broken inversion symmetry. The existence of magnetic antiskyrmions has been recently demonstrated in thin plates of a tetragonal Heusler material with D_{2d} crystal symmetry. Here, the robust nature of the antiskyrmion phase in bulk tetragonal Mn–Pt(Pd)–Sn compounds by utilizing magnetic entropy change and AC-susceptibility measurements is shown. It is found that the formation of the antiskyrmion phase is accompanied by a positive magnetic entropy change, which is supported by the concomitant observation of an anomaly in AC-susceptibility measurements. Supporting these findings, no anomalies are found in AC-susceptibility and magnetic entropy change measurements for a Mn–Pt(Pd)–Sn compound that is stabilized in the cubic phase by slight changes in chemical composition, thereby showing the robustness of the antiskyrmion phase to the D_{2d} crystal structure.

between the Heisenberg exchange and the DMI leads to a spin helix ground state,[2–6] which breaks into skyrmions with the application of external magnetic fields. For the realization of skyrmion-based spintronic devices, the stabilization, detection, and manipulation of skyrmions over a wide range of temperature (T) becomes a most intriguing research challenge. From a materials perspective, the vast spintronic materials community of Heusler compounds (X_2YZ, with X, Y: transition metals and Z: a main group element) are of special interest owing to their low damping parameters ($\approx 10^{-3}$), high spin polarization, high ordering temperatures, and compositional tunability towards desired functionality.[10–13] Specifically, Mn-rich Heusler compounds crystal-

Institute :NISER

CHEMISTRY OF MATERIALS
Article
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Enhanced Magnetic Properties of In−Mn-Codoped Plasmonic ZnO Nanoflowers: Evidence of Delocalized Charge Carrier-Mediated Ferromagnetic Coupling

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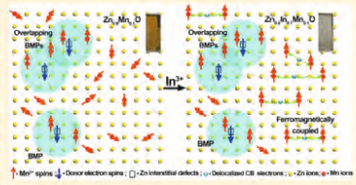
Supporting Information

ABSTRACT: We report a detailed study of temperature and magnetic field dependence of the magnetization of free-standing colloidal Mn-doped and In−Mn-codoped ZnO nanoflower (NF) powders, including their optical spectroscopic properties to explore the delocalized charge carrier (conduction band electron)-mediated ferromagnetic coupling in dilute magnetically doped semiconductor (DMS), which could empower the next-generation spin-based information technologies. In the present investigation, all samples are characterized by the hexagonal wurtzite ($P6_3mc$) crystal structure, although the hexagonal shape of pure ZnO nanocrystals is transformed into the flowerlike morphology with Mn doping and In−Mn codoping. The Zn interstitial defects, traced through the blue photoluminescence emissions, have been found to form bound magnetic polarons (BMPs) in the presence of spin-↑ Mn^{2+} ions in $Zn_{0.9}Mn_{0.1}O$ NFs. The overlapping of these BMPs typically leads to above-room-temperature ferromagnetism in $Zn_{0.9}Mn_{0.1}O$ NFs. Exclusively, the significant enhancement in magnetization value at 50 kOe (∼18%) and coercivity (∼10 times) have been identified on codoping with In^{3+} ions, i.e., for $Zn_{0.8}In_{0.1}Mn_{0.1}O$ NFs, originating from the delocalized conduction band electrons as evident from the plasmonic absorption, which induce new ferromagnetic coupling between Mn^{2+} ions via themselves. Here, we unfold for the first time a truly fascinating phenomenon of delocalized charge carrier-mediated ferromagnetic coupling in In−Mn-codoped plasmonic ZnO NFs, which significantly improves the ferromagnetism in Mn-doped ZnO DMSs.



Institute :NISER

Growth of Wafer-Scale ReS_2 with "Tunable" Geometry toward Electron Field-Emission Application

Mohit Kumar, Dae Young Park, Ranveer Singh, Mun Seok Jeong, Tapobrata Som* and Joondong Kim*

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Abstract

Despite high potential, the promise of 2D materials has not been realized practically because of limits of tiny grown size and difficult manipulation of the active spot. The utilization of 2D layers is the ultimate approach, which should be supported by large-scale production. In this very first report, we demonstrate the wafer-scale production of ReS_2 using the conventional sputtering method. The controllability of ReS_2 geometry has been investigated to form typical thin films or vertically aligned layers that are further applied for field emission. The vertically aligned ReS_2 layers exhibit ultralow turn-on electric field (0.6 V μm^{-1}) with the current density (0.6 mA cm^{-2}) and significantly low threshold electric field (0.8 V μm^{-1}), respectively, along with outstanding emission stability. The results are attributed to weakly coupled ReS_2 layers and the high geometrical field enhancement factor (∼1.08×10^5). Further, Kelvin probe force microscopy measurements confirm that lowering the work function is not solely responsible to achieve the ultralow operative field. Moreover, finite element simulation suggests that not only the length, width, and separation of the nanostructures but also the local slope plays an important role in suppressing screening effects.

Institute :IOP

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Ground-State Heterogeneity along with Fluorescent Byproducts Causes Excitation-Dependent Fluorescence and Time-Dependent Spectral Migration in Citric Acid-Derived Carbon Dots

Krishna Mishra, Somnath Koley, and Subhadip Ghosh*

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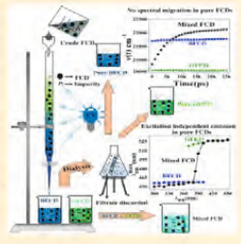
Supporting Information

ABSTRACT: The integrity of fluorescent carbon dot (FCD) emission deserves its highest appreciation when sample purification is performed with extreme care. Several controversial phenomena of FCD fluorescence including excitation-dependent emission, spectral migration with time, and thereby violation of the Kasha−Vavilov rule, which sparked intense debate during recent reports, disappeared when we rigorously purified the as-synthesized FCD sample. Purification was performed by first visual silica column chromatography (observing the emissions under UV illumination) and subsequently prolonged membrane dialysis. Most of the surprising phenomena of FCD fluorescence reported earlier apparently arose from ground-state spectral heterogeneity of FCD sample containing a large amount of fluorescent impurities (mostly polymeric or oligomeric in nature). Observation of our ensemble spectroscopic measurements, albeit nicely matched with recent reports based on single-particle experiments, differed largely from that of other ensemble measurements. Our results reconciled a number of long-standing controversies on FCD emission mostly by emphasizing the urgency of sample purification with more scientific rigor.



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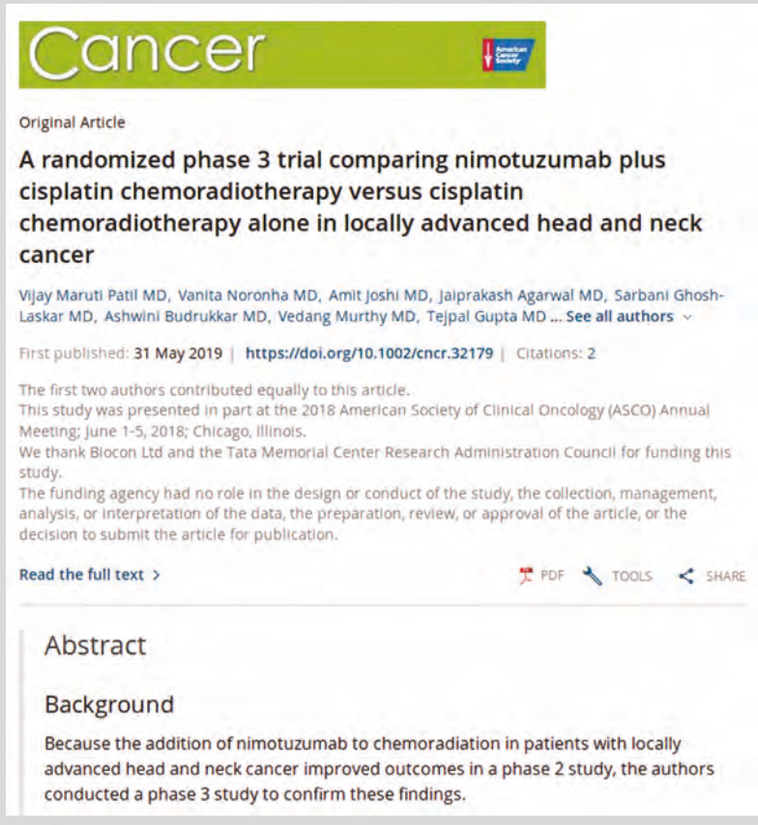
Predicted $M(H_2)_{12}^{n+}$ (M = Ac, Th, Pa, U, La and n = 3, 4) complexes with twenty-four hydrogen atoms bound to the metal ion†

Meenakshi Joshi [ab] and Tapan K. Ghanty *[ab]

Herein, we have shown that La(III), Ac(III), Th(III), Th(IV), Pa(IV) and U(IV) can directly bind with a maximum of 24 hydrogen atoms in $M(H_2)_{12}$ in the first sphere of coordination, which would be a new record in any metal–hydrogen complex investigated at the molecular level, where all the hydrogen atoms are directly connected to the central metal ion through M–$\eta^2(H_2)$ bonds. Moreover, $Ac(H_2)_n^{3+}$ (n = 9–12) systems satisfy the 18-electron rule.

coordinate or covalent bonds or the number of neighbouring atoms in the first coordination sphere of a metal atom/ion.[7] However, with time this definition has been modified for different ligands such as ethene or cyclopentadienyl, which are considered to occupy one and three coordination sites, respectively. Though the high coordination numbers (CN = 12–16) of actinides in $[U(NO_3)_6]^{2-}$,[8] $[Th(NO_3)_6]^{2-}$,[9] $M(BH_4)_4$[10] (M = Th, Pa, U, Pu, Np), and $[Th(H_3BNMe_3BH_3)]$,[11] and Cs in $Cs[H_2NB_2(C_6F_5)_6]$[12] com-

Institute: BARC



Cancer

Original Article

A randomized phase 3 trial comparing nimotuzumab plus cisplatin chemoradiotherapy versus cisplatin chemoradiotherapy alone in locally advanced head and neck cancer

Vijay Maruti Patil MD, Vanita Noronha MD, Amit Joshi MD, Jaiprakash Agarwal MD, Sarbani Ghosh-Laskar MD, Ashwini Budrukkar MD, Vedang Murthy MD, Tejpal Gupta MD ... See all authors

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The first two authors contributed equally to this article.
This study was presented in part at the 2018 American Society of Clinical Oncology (ASCO) Annual Meeting; June 1-5, 2018; Chicago, Illinois.
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The funding agency had no role in the design or conduct of the study, the collection, management, analysis, or interpretation of the data, the preparation, review, or approval of the article, or the decision to submit the article for publication.

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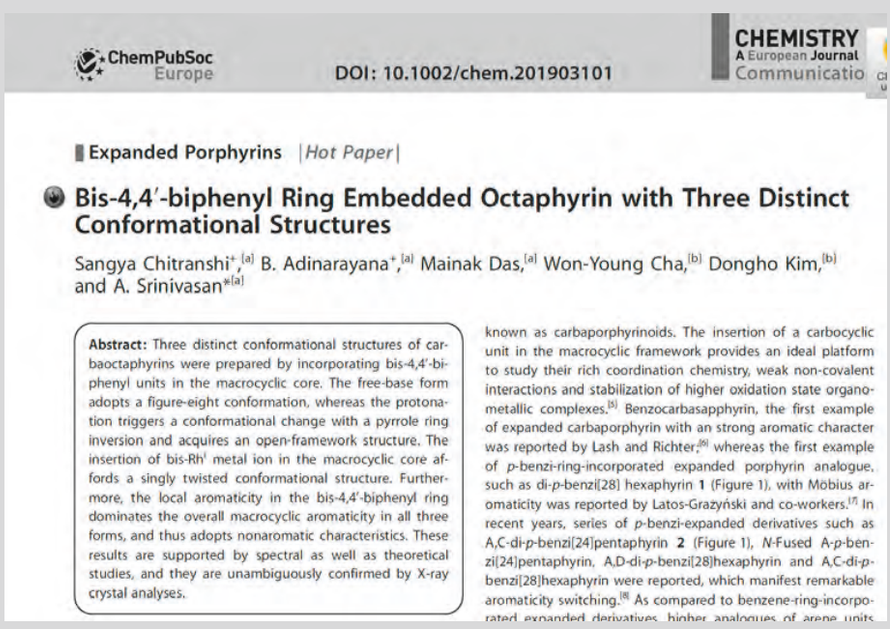
Abstract

Background

Because the addition of nimotuzumab to chemoradiation in patients with locally advanced head and neck cancer improved outcomes in a phase 2 study, the authors conducted a phase 3 study to confirm these findings.

Institute: TMH, TMC



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Expanded Porphyrins | *Hot Paper*

Bis-4,4′-biphenyl Ring Embedded Octaphyrin with Three Distinct Conformational Structures

Sangya Chitranshi[+,a] B. Adinarayana[+,a] Mainak Das,[a] Won-Young Cha,[b] Dongho Kim,[b] and A. Srinivasan*[a]

Abstract: Three distinct conformational structures of carbaoctaphyrins were prepared by incorporating bis-4,4′-biphenyl units in the macrocyclic core. The free-base form adopts a figure-eight conformation, whereas the protonation triggers a conformational change with a pyrrole ring inversion and acquires an open-framework structure. The insertion of bis-Rh^{I} metal ion in the macrocyclic core affords a singly twisted conformational structure. Furthermore, the local aromaticity in the bis-4,4′-biphenyl ring dominates the overall macrocyclic aromaticity in all three forms, and thus adopts nonaromatic characteristics. These results are supported by spectral as well as theoretical studies, and they are unambiguously confirmed by X-ray crystal analyses.

known as carbaporphyrinoids. The insertion of a carbocyclic unit in the macrocyclic framework provides an ideal platform to study their rich coordination chemistry, weak non-covalent interactions and stabilization of higher oxidation state organometallic complexes.[5] Benzocarbasapphyrin, the first example of expanded carbaporphyrin with an strong aromatic character was reported by Lash and Richter,[6] whereas the first example of *p*-benzi-ring-incorporated expanded porphyrin analogue, such as di-*p*-benzi[28] hexaphyrin **1** (Figure 1), with Möbius aromaticity was reported by Latos-Grazyński and co-workers.[7] In recent years, series of *p*-benzi-expanded derivatives such as A,C-di-*p*-benzi[24]pentaphyrin **2** (Figure 1), *N*-Fused A-*p*-benzi[24]pentaphyrin, A,D-di-*p*-benzi[28]hexaphyrin and A,C-di-*p*-benzi[28]hexaphyrin were reported, which manifest remarkable aromaticity switching.[8] As compared to benzene-ring-incorporated expanded derivatives, higher analogues of arene units

Institute: NISER

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Effect of yttrium variation on phase, transparency, and micro-structure of neodymium doped yttrium aluminum garnet ceramic

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ABSTRACT

Neodymium doped transparent yttrium aluminum garnet ceramics with yttrium excess and deficient (1 to 3 mol %) compositions were fabricated. The samples with stoichiometric and 1.0 mol% yttrium excess are transparent. However, 1.0 mol% yttrium deficiency samples are opaque. The structural and compositional analysis corroborates the presence of alumina as secondary phase for yttrium deficient compositions and yttrium aluminum perovskite for yttrium excess compositions. It is found that yttrium deficiency is highly detrimental to the transparency as compared to yttrium excess. The solubility width of garnet phase is found to be lower than 1.0 mol% for yttrium excess and deficiency.

Institute: RRCAT

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    Subramanian Thiyagarajan Chidambaram Gunanathan
    ACS Catal.2018832473-2478
    Institute: NISER, Citations: 15

Integrating the function of a university to a work place to promote post-academic research

R. B. Grover

Earlier universities had 'teaching' and 'research' as two missions and in recent times 'contributing directly to industry' has been added as the third mission. Considering that work places generate and disseminate knowledge, one can integrate the functions of a university to a work place. The author was involved in the implementation of such an integration and this article is an outcome of that experience. The article presents a summary of the relationship between science and technology, describes policy statements related to science and technology issued by the Government of India, and glimpses into the structure of research establishment in India. The Ministry of Human Resource Development (MHRD) is tasked with setting up Higher Education Institutions (HEIs), and its efforts have been supplemented by many other agencies of the Government. Agencies other than MHRD, including mission-oriented agencies, have oriented the HEIs established by them to cater to the needs of the business allocated to them. The article lists the motivations for setting up an HEI by a mission-oriented agency, where the idea of integrating the university function to a work place has been implemented.

Keywords: HEIs by agencies other than MHRD, methods of knowledge production, relationship between science and technology, S&T policy.

TOOLS and crafts developed by humans based on empirical, but highly systematic and intuitive approach, beginning from hunter–gatherer days have evolved into present-day technologies. This development, for the most part of human history, was independent of the quest for knowledge, pursued for the sake of knowledge by savants and well-endowed individuals. However, Bush[1] proposed a linear model stating that basic science leads to technological development and this became the basis for scientists to seek, and for funding agencies to provide, funding for research and the slogan 'knowledge for the sake of knowledge' became a manifesto of many scientists after the second world war. Surveys of inputs resulting in developments of new products and processes were done and the result was a challenge to the linear model. A reverse linear model emphasizing that new scientific possibilities created by technology was proposed and by 1972, the science historian bid farewell to the linear model[2]. Stokes[3] proposed a two-dimensional model and coined the term 'use-inspired basic research'. Models of the relationship between science and technology (S&T) proposed during recent decades are non-hierarchical, acknowledge full intertwining and mutual dependence of S&T, and semi-autonomous progress forward. Empiricism used to build on existing technology pursued prior to about mid-19th century is now being supplemented, in some instances replaced, by tools based on engineering science and natural sciences.

Grover[4] has summarized the complex relationship between science and technology, evolution of engineering science as a discipline, constantly evolving relationship between research and its application, changes that are taking place in methods of knowledge production, and opined: 'work places such as industry, consultants, non-governmental think tanks, and international agencies are store-houses of knowledge; they use knowledge as well as generate and disseminate knowledge. Knowledge production, therefore, is now distributed across many agencies. It is not a new element. Prior to the advent of research universities and laboratories, work places were generating knowledge and they are doing so again now'.

It is difficult to define knowledge precisely. It is a broad concept and includes phenomenological knowledge, observable facts, knowledge embodied in products, processes and systems, knowledge gained from operation of plants and facilities, and professional practices. The stock of knowledge is increased by research. Research also provides new applications of available knowledge. For an activity to be classified as research or research and experimental development, it has to be novel, creative, systematic, transferable and/or reproducible and its outcome should have uncertainty[5].

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Acknowledging that categorizing research is difficult and using the terminology proposed by Ziman[6], Grover[4] has suggested simple categorization – academic research and post-academic research. 'Both academic and post-academic research can have epistemic and use objectives. Dominant objective in the case of the academic research is epistemic. It can have immediate (as against distant) utilization as its sub-objective and it may or may not be a scheduled activity. On the other hand, post-academic research is pursued with use as the end goal, and it will always have an epistemic sub-objective.' Using these arguments, the author has proposed a representation of the relationship between science and technology (Figure 1) that recognizes their intertwining and acknowledges that the progress in one depends on itself and the other. The boundary between academic and post-academic research is not sharp, rather there is a large overlap between the two, and post-academic research is invariably accompanied by development. In an organization pursuing post-academic research, knowledge is produced at the point of application, while knowledge flows from academic institutions to industry through technology transfer and translational research.

Earlier universities had two missions that are 'teaching' and 'research' and in recent times 'contributing directly to industry' has been added as the third mission. One may expand the third mission as contribution to industry and society to include fields other than STEM. A university accomplishes its missions by performing functions such as imparting skills and knowledge through course work and training for research based on structured programmes, providing certification, and encouraging socialization[7]. 'Considering that work places generate and disseminate knowledge, one can think of the idea of integrating the functions of a university to a carefully chosen work place.' This is regularly practised in health sciences as every medical school is attached to a hospital. The present author was intimately associated with the process of setting up a university-level institute that is Homi Bhabha National Institute (HBNI), which implements the idea of integrating the function of a university to a cluster of R&D centres – that is a work place[8].

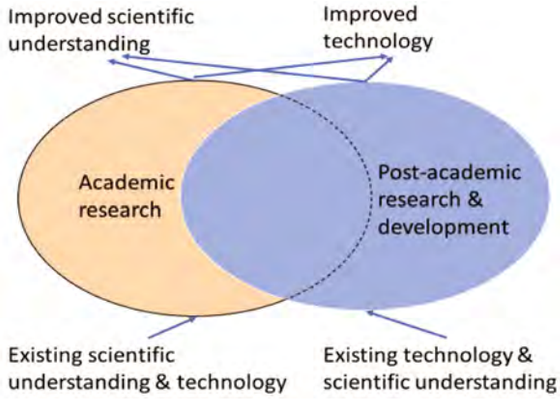

Figure 1. A representation of the relationship between science and technology. Note: The words 'scientific understanding' used in the figure represents understanding in all branches of science including natural sciences, engineering sciences, health (or medical) sciences, agricultural sciences and social sciences.

This article examines the science and technology policy statements issued by the Government of India, the structure of research establishment in India, and setting up HEIs by agencies of the Government of India other than MHRD, specifically HBNI by the Department of Atomic Energy.

Policy statements

University education was given high importance after India achieved independence in 1947 and an early initiative was to constitute a ten-member commission, consisting of educationists from India, the UK and the USA, chaired by S. Radhakrishnan 'to report on Indian University Education and suggest improvements and extensions that may be desirable to suit present and future requirements of the country'. The focus of the report is education, but it does touch upon issues related to research, and the importance of the linkages between universities, and research and development institutions[9]. It acknowledges the overlap between basic and applied research, and describes the interest of the Government of India in scientific research as utilitarian to aid agriculture, industry, medicine, engineering, etc.

Report of the Education Commission set up under the leadership of D. S. Kothari is another comprehensive report and expresses 'deep conviction that the progress, welfare and security of the nation depend critically on a rapid, planned and sustained growth in the quality and extent of education and research in science and technology'[10]. The report cautions that academic research (referred by them as pure research) can drive away post-academic research (referred by them as applied research) unless due emphasis is placed on the latter[10] and calls for prioritizing research geared to meet national needs. The report also calls for inviting selected scientists from national laboratories to participate in teaching and research in universities.

Draft report of the committee chaired by Kasturirangan recommends setting up a National Research Foundation for competitive peer-review funding, establishing research universities, and empowering affiliated colleges to grant degrees[11].

Various laboratories in India have been recognized as centres for conducting doctoral research and scientists working in laboratories have been recognized as research advisors. A programme called 'external registration', launched in 1972 by the Indian Institute of Science and

adopted by some other institutes, further strengthened doctoral research in laboratories. This feature is not unique to India and similar programmes, albeit with variations, exist in other countries. For example, CEA laboratories in France have about one thousand students pursuing doctoral research at any given time. DOE, USA facilitates students, pursuing doctoral research in universities, to do a part of their research in DOE laboratories.

The Government of India constituted several other commissions and committees to reform education[12], but the focus in most cases is education. One frequently made comment about higher education is that the faculty lacks experience in industry and therefore, teaching has a strong bias towards theory[13].

In May 1971, the Government of India established the Department of Science and Technology (DST) with the objective of playing the role of a nodal department for organizing, coordinating and promoting S&T activities, and also formulate policies related to S&T. While the first policy statement was issued prior to establishing DST, subsequently three more statements have been issued. The statements are the following: (i) The Science Policy Resolution (SPR), 1958; (ii) The Technology Policy Statement (TPS), 1983; (iii) The Science and Technology Policy (STP), 2003, and (iv) The Science, Technology and Innovation Policy (STI), 2013.

Evolution in the title of the documents is revealing. First only science, then only technology, then both together and finally innovation added to science and technology.

An imprint of the linear model can be seen in the SPR-1958 when it says, 'technology can only grow out of the study of science and its applications'. The linear model is also present in the TPS-1983. It says, 'Given clear-cut objectives and the necessary support, our science has shown its capacity to solve problems'. It also says, 'consolidation of the existing scientific base and selective strengthening of thrust areas in it are essential. Special attention will be given to the promotion and strengthening of the technology base in newly emerging and frontier areas such as information and materials sciences, electronics and bio-technology'. This quote begins with the consolidation of scientific base and then moves to technology without bringing linkage between the two. The statement goes on to say, 'The time cycle from scientific research to utilization is a long one'. This again is a reference to the linear model, though the policy statement does not include examples to explain the thinking.

Change is visible in STP-2003, when the title of the document then issued changes to Science and Technology Policy. The document says, 'Science and technology have become so closely intertwined, and so reinforce each other that, to be effective, any policy needs to view them together'. The policy also talks about 'basic research in science, medical and engineering institutions' and acknowledges that 'a strong base of science and engineering research provides a crucial foundation for a vibrant programme of technology development'. This policy statement places science and engineering on equal footing and acknowledges their interdependence.

However, STI-2013 presents a mixed picture. It acknowledges that the 'Science and Technology Policy of 2003 brought science and technology together', but maintains that 'scientific research utilizes money to generate knowledge and by providing solutions converts knowledge into wealth and/or value'. In the subsequent part of the statement, science and technology appear together. The above quote seems to disown knowledge generated during the process of technology development. The statement also brings in 'innovation' in the debate. Innovation is larger than technology, which in turn is larger than science and all three are interdependent and distinct[14]. Innovation consists of several activities and R&D may or may not be a part of the activity of innovation. Innovation includes some or all of the following: R&D that is generating new knowledge or a new application of available knowledge, acquisition of existing knowledge, machinery, equipment and other capital goods, training, marketing, design and software development[5].

The statements have tried to steer clear of the debate regarding categorization of research or the perceived divide between science and technology, but it is clear that the linear model was woven into the thinking of the experts who drafted the statements SPR-1958, TPS-1983 and STI-2013. Utilitarian aspect of research is underscored by all the four statements.

Structure of the research establishment

Government of India has set up several establishments for pursuing research. To understand their structure and spread, one can categorize them, with categories not representing any hierarchy, as follows. The first category consists of mission-oriented departments that are characterized by the fact that they pursue research in the laboratories administered and funded by them, and also utilize the research output. They are thus their own clients and this is a recipe for success. These include the Department of Atomic Energy (DAE), Department of Space (DOS), and Defence Research and Development Organisation (DRDO). Research and development units, industrial units and funding agencies dedicated to fund research related to their mission are part of the mission-oriented departments; their internal structure is an acknowledgement of the intertwining of science and technology. Support to industrial laboratories provides right climate for creation of technologies and novel discoveries[15].

In the second category are Councils like the Indian Council of Medical Research (ICMR), the Indian Council of Agricultural Research (ICAR), the Council of Scientific and Industrial Research (CSIR), and the Indian Council

of Forestry Research and Education (ICFRE). They have their own institutes or laboratories and are, thus, hands-on agencies. They are also engaged in human resource development and fund extra-mural research. The ICAR has played a pioneering role in increasing the production of food grains, eggs, fish, milk and horticultural products in India through research and technology development.

In the third category are departments like the Department of Science and Technology, and the Department of Bio-Technology, which fund research in Higher Education Institutes (HEIs), though they do have some institutions that are directly administered by them.

In the fourth category are Universities (Central, State, Deemed and Private), HEIs like Indian Institutes of Technology (IITs), Indian Institute of Science (IISc) and Indian Institutes of Science Education and Research (IISER). Institutions for scientific and technical education financed by the Government of India have been declared by the Parliament to be institutions of national importance that is INIs such as IITs and IISERs. IISc, IITs, IISERs and Central Universities are funded by MHRD.

In the fifth category are establishments and HEIs set-up or administered by other departments and ministries such as the Department of Pharmaceuticals, the Ministry of Petroleum and Natural Gas, and the Ministry of Statistics and Programme Implementation.

In the sixth category are surveys like Geological Survey, Archaeological Survey and Zoological Survey. They are engaged in specific functions.

Research establishment in India, thus, has a distributed structure. The intertwining of science and technology has been acknowledged in setting up institutions, but a disconnect is seen between policy statements and setting up of institutions. SPR-1958 gives primacy to science, but the first institutes set up by the Government of India were IITs. TPS-1983 is oriented towards technology and was issued when five IITs had already been set-up. Setting up of IISERs was taken up during the middle of the first decade of this century – when STP-2003 placed science and technology on equal footing.

Setting up of universities by the central agencies other than MHRD

Ministries and Departments of the Government of India perform functions assigned to them through 'Allocation of Business Rules', which can be seen on the website of the Cabinet Secretariat. They have set up research centres and have also HEIs accredited to perform university functions tailored to their needs in the area of education and training, as well as research and development. While a beginning regarding setting up HEIs was made in 1950s, this trend has accelerated in recent decades (see Table 1 for details). Some of the HEIs listed in the table were set up as a research centre or a learned society, but became deemed universities or INIs subsequently; for example, the Tata Institute of Fundamental Research, and the Indian Statistical Institute.

To understand the motivation of agencies other than MHRD in setting up accredited HEIs, one has to recall the relationship between science and technology, how knowledge is produced, and utilization aspect of knowledge. Motivations listed later in this section are based on the experience of the author in setting up HBNI[8] and issues related to human resource development for nuclear energy programme in India[16]. Some of the motivations are applicable in similar other cases. Demands of inter-disciplinarity of real-life situations, and the knowledge base and skill-set requirements are unique to a business. Agencies other than MHRD have oriented their HEIs to cater to their needs. In some cases, a desire to run academic programme efficiently has also been a motive.

DAE has set up research and development centres and also provides full funding for running grant-in-aid institutions. HBNI was set-up as a deemed university to integrate human resource development programmes ongoing in 10 institutions of DAE under a single academic framework and expand the programmes. National Institute for Science Education and Research was set up subsequently and is an off-campus centre of HBNI. Annexure 1 lists all the institutions of HBNI. While NISER, SINP, IoP, IMSc, HRI are akin to conventional university institutions, research and development centres are work places engaged in: (i) post-academic research; (ii) design, development, construction and operation of mega research and first-of-a-kind (FOAK) fuel cycle facilities, and (iii) design and development of FOAK nuclear power plants. IPR has a hybrid character and mandate of TMC includes treatment, research and education focused on post-graduate (MD) and super-specialty programmes (DM and M Ch) in oncology.

HBNI has a distributed structure and pursues research in areas related to missions assigned to DAE. Doctoral programmes, post-graduate and super-specialty medical programmes have seen significant expansion (see Figures 2 and 3) since setting up HBNI. About 40% of doctorates have been completed by employees of DAE. *Nature*, in its issue dated 20 September 2018, has included HBNI in the category of 'Rising Stars'. The approved annual intake for the post-graduate and the super-specialty medical programme for the academic session starting in mid-2018 was 129. Completing one-year of course work is compulsory for scientists and engineers joining DAE establishments through BARC Training School, and doing one-year of project to complete an M Tech is an option available to engineering graduates. Since inception, 1236 students have completed M Tech. Number of students who have completed a Ph D in engineering science is 194 out of a total of 1363 (Figure 4). HBNI also offers several programmes that aim at development of skills. These include Diploma in Radiation Protection (for

Table 1. HEIs administered by Departments and Ministries other than MHRD

Ministry/department	HEI (year of establishment as an HEI)
Ministry of Railways	The National Rail and Transport Institute*, Vadodara (2018)
Ministry of Petroleum and Natural Gas (MOP&NG)	Indian Institute of Petroleum and Energy*, Visakhapatnam (2018)
Department of Science and Technology (DST)	Indian Association for the Cultivation of Science** (2018)
Ministry of Food Processing Industries	National Institute of Food Technology Entrepreneurship and Management**, Sonipat (2012)
Ministry of Health & Family Welfare (MH&FW)	National Institute of Mental Health and Neurosciences*, Bengaluru (2012)
Department of Industrial & Scientific Research	Academy of Scientific and Industrial Research* (2011)
Ministry of Defence (MOD)	Indian National Defence University*, approved in 2010 and now coming up in Gurugram
MOP&NG	Rajiv Gandhi Institute of Petroleum Technology*,Rae Bareli (2008)
MH&FW	Post-Graduate Institute of Medical Education and Research*, Chandigarh (2008)
Department of Space	Indian Institute of Space Science and Technology**, Thiruvananthapuram (2007)
Department of Atomic Energy (DAE)	Homi Bhabha National Institute**, Mumbai (2005)
DAE	Tata Institute of Fundamental Research**, Mumbai (2002)
Ministry of Commerce & Industry	Indian Institute of Foreign Trade** (2002)
MOD	Defence Institute of Advanced Technology**, Pune (2000)
Dept of Pharmaceuticals	National Institute for Pharmaceutical Research*, Mohali (1998); and now at six more places
Ministry of Environment, Forests & Climate Change	Forest Research Institute**, Dehradun (1991)
Ministry of Agriculture & Farmer's Welfare: Indian Council of Agriculture Research (MA&FW-ICAR)	ICAR-National Dairy Research Institute**, Karnal (1989); ICAR-Central Institute of Fisheries Education**, Mumbai (1989) ICAR-Indian Veterinary Research Institute**, Izatnagar (1983)
DST	Sree Chitra Tirunal Institute for Medical Sciences and Technology*, Thiruvananthapuram (1980)
MH&FW	Jawaharlal Institute of Postgraduate Medical Education and Research*, Puducherry (1966)
Ministry of Statistics & Programme Implementation	Indian Statistical Institute*, Kolkata (1959)
MA&FW-ICAR	ICAR-Indian Agricultural Research Institute**, New Delhi (1958)
MH&FW	All India Institute of Medical Sciences*, New Delhi (1956) and now at six more places

*An institute of national importance; **A deemed to be University.

Notes: (a) HEIs are listed in reverse chronological order. (b) In case of multi-campus institutes, the city where the headquarter is located is indicated in the table. (c) The table does not list HEIs engaged in vocational education, or research in fields other than STEM. These include the following: (1) Ministry of Textiles established National Institute of Fashion Technology having 15 campuses in 1986 and it became an INI in 2006; (2) Ministry of Shipping has set up Indian Maritime University under an Act passed in 2008; (3) Ministry of Civil Aviation established Rajiv Gandhi National Aviation University in 2013, and all flying schools are expected to get affiliated to it. At present it offers only short-term diploma programmes; (4) Ministry of Commerce and Industry established Footwear Design and Development Institute having 12 campuses in 2006. It became an INI in 2017; (5) Ministry of Commerce & Industry has set up Indian Institute of Packaging as a non-formal institute; (6) Department of Corporate Affairs has set up Indian Institute of Corporate Affairs (non-formal); (7) Ministry of Culture has three HEIs dealing with Buddhist Studies.

training students to work as Radiation Safety Officers), Diploma in Medical Radio-Isotope Technology, Diploma in Fusion Imaging Technology and M Sc in clinical research.

Motivations for setting up HBNI from the perspective of the author are as follows.

(i) The field of nuclear science and engineering is the result of splicing of several fields of science and engineering and therefore, running academic programmes in this area requires setting up facilities necessary to provide training and conduct experimental research, and recruit faculty belonging to several disciplines. It does not lend itself to a silo-based approach. This is applicable to some other fields as well such as Biomedical Engineering[13]. The issue of faculty resources becomes acute as many of the specializations needed by DAE to cover missions assigned to it are unique. Examples include accelerator science and technology, high-frequency engineering, nuclear chemistry, reactor physics, plasma physics, nuclear fuels, nuclear chemical engineering, molten salts chemistry, liquid metal heat transfer, radiation damage resistant materials and so on. In units of DAE, all such resources already exist and HEIs in India do not have large faculty resources[17].

(ii) The increasing complexity of technological systems is driving the development of analytical, computational and simulation tools. This requires design tools and analytical methods grounded in phenomenological understanding. This is particularly important for anticipating failure modes under extreme but conceivable conditions

Annexure 1. Constituent institutions and the off-campus centre of HBNI

Constituent institutions

(i) Research and development centres of the Department of Atomic Energy:
- (a) Bhabha Atomic Research Centre (BARC), Mumbai
- (b) Indira Gandhi Centre for Atomic Research (IGCAR), Kalpakkam
- (c) Raja Ramanna Centre for Advanced Technology (RRCAT), Indore
- (d) Variable Energy Cyclotron Centre (VECC), Kolkata

(ii) Grant-in Aid Institutions under the administrative control of the Department of Atomic Energy:
- (a) Saha Institute of Nuclear Physics (SINP), Kolkata
- (b) Institute for Plasma Research (IPR), Gandhinagar
- (c) Institute of Physics (IoP), Bhubaneswar
- (d) Harish-Chandra Research Institute (HRI), Allahabad
- (e) Tata Memorial Centre (TMC), Mumbai
- (f) The Institute of Mathematical Sciences (IMSc), Chennai

Off-campus centre

National Institute for Science Education and Research (NISER), Bhubaneswar

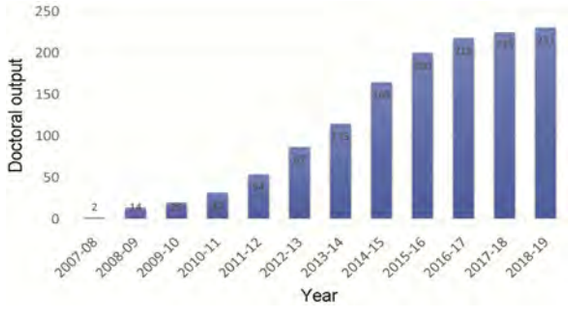

Figure 2. Year-wise doctoral output from Homi Bhabha National Institute.

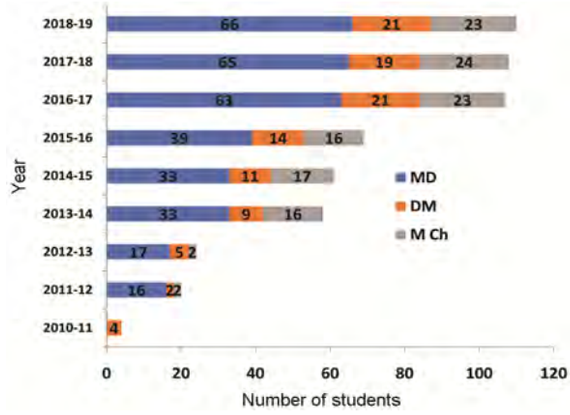

Figure 3. Year-wise output of MD/DM/M Ch from Homi Bhabha National Institute.

of service of complex technological systems. In fact, this is the major activity that comprises engineering research. In this kind of research, the element of practice is as important as the element of theory, is contextual and lies at the intersection of academic and post-academic research (Figure 1). As DAE establishments had been pursuing contextual research, adding the mission of human resource development to its existing missions was a natural next step.

(iii) Developing new technology, or improving or finding a new application of an existing technology can throw unforeseen challenges and could require inputs based on research. Even when DAE lays emphasis on post-academic research, pursuit of academic research (note the large intersection of academic and post-academic research in Figure 1) is necessary to have in-house experts in relevant areas, who can help in addressing unusually difficult challenges requiring new knowledge. Selection of subject areas for academic research has to be skillfully managed for their relevance to the mission of the DAE. Many such areas, as already explained, may not be of general interest, and so are not pursued by HEIs. The result is that mission-oriented agencies, in general, find it difficult to get support from HEIs in the country in all areas of interest to them. In all such cases, mission-oriented agencies have to pursue academic research in their own research centres and when possible, supplement their own efforts by funding such research in HEIs.

(iv) Nuclear technology is subject to technology controls and many artefacts must be reinvented as they cannot be imported. Value system for recognition and promotion followed by HEIs in India makes faculty generally reluctant to pursue research in such areas.

The students are viewed sometimes as low cost, but valuable man power, and sometimes as distraction. This divide was evident within DAE during the debate for setting up HBNI. While some in the top decision-making bodies viewed students as 'distraction' and the university function 'a strain', majority favoured it. Research and development centres, and industrial laboratories tend to have static work forces, which is necessary to provide continuity of skills. In such work-places students are not a distraction, but a source of innovation, which is a necessary element for the development of technologies by

mission-oriented agencies. According to Etzkowitz and Leidesdorff[18], students 'represent a dynamic flow-through of 'human capital' in academic research groups'. The permanent scientific staff consisting of scientific officers and technical support personnel provides continuity of skills, and students provide dynamism. The resulting atmosphere can provide ideas for future technologies and scientific discoveries. Considering importance of the contribution of scientific officers, HBNI has been set up in a manner that the reward-system existing in the R&D centres has not been disturbed. Promotions in R&D centres are decided by contribution of an individual to the mission of the Department and not solely on the basis of publications and citations thereof. Globally, academia has a tendency to aim at peer recognition, which comes from publications. However, one has to strike a balance between international recognition and national needs[13].

R&D centres of DAE, which are also Constituent Institutions of HBNI, are engaged in the design and development of a FOAK high-tech projects requiring scholarly inputs from multi-disciplinary teams and calling for combining theory and practice with greater intensity. This involves a large number of experts belonging to different disciplines working together in a team over a long-time frame. System engineering, interface management and configuration control become dominant challenges during the implementation of such projects. Doctoral students interact with faculty who also double as scientific officers and grapple with complex problems while implementing FOAK projects. This inculcates in the students an appreciation and respect for post-academic research, design and development including development of experimental methods and devices, and industrial work. Such developments are important and have led to Nobel prizes[19].

Every institution has certain norms, values and beliefs. Educationists refer to it as 'hidden curriculum' as it is conveyed to students not through explicit means, but by shaping their behaviour based on socializing mechanisms on the campus. Respect for industrial work, design and development, and post-academic research is the hidden curriculum of the doctoral programme (particularly at some of the institutions viz. BARC, IGCAR, RRCAT, VECC and IPR) of HBNI.

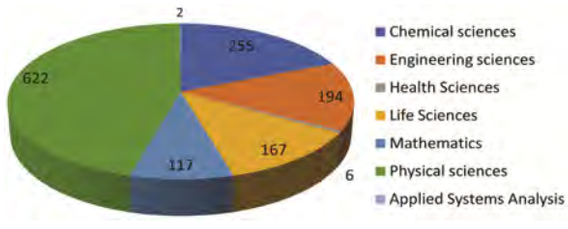

Figure 4. Discipline-wise doctoral output from Homi Bhabha National Institute.

DAE has several institutions and working under a single academic umbrella has been helpful in bringing these institutions together and benefit from the expertise of each other. The number of engineering graduates pursuing Ph D has significantly increased and the number of students making use of mega facilities for doctoral research at R&D centres has also increased.

Every institute provides an environment to researchers and that includes elements like its mission, its culture (meritocracy, transparency and entrepreneurship), leadership that defines the balance between the focus and the freedom[15]. In an institute like HBNI, the balance has a tilt towards focus on research related to the mission of the DAE, while in a conventional HEI, the tilt is towards freedom to select topics for research including freedom to keep switching the topics.

HEIs, set up by agencies other than MHRD, are supplementing the existing HEIs and research by them has a focus on the business allocated to them. However, HBNI is unique because of its distributed structure, recognition of researchers in R&D centres as faculty following stringent criteria, and use of existing research infrastructure for doctoral research. It also endorses utilitarian aspect of research emphasized by all policy statements. HBNI is, thus a new idea of a university and is an addition to the several ideas of a university that are co-existing[20].

Concluding remarks

The structure of institutions in India, particularly mission-oriented agencies, acknowledges intertwining of science and technology.

To continue to generate new knowledge and to utilize all available knowledge, HEIs that combine theory and practice with much greater intensity are needed, and most of the HEIs nurtured by agencies other than MHRD are eminently suited to do so. Research nurtured in a majority of the institutions of HBNI is a mix of academic and post-academic with a tilt toward the latter, and focus on the missions assigned to DAE.

HBNI has been established in a manner that the reward system prevalent in the research centres including that for scientific officers has not been disturbed. Research centres continue to give equal status to faculty and scientific officers.

For higher education, India has adopted a hybrid model, where unitary universities, affiliating universities, and single (or limited) discipline(s) institutions co-exist. HBNI with its distributed structure and focus on its mission is a new idea of a university and represents the continuing evolution of the idea of a university.

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AWARDS AND HONORS

- Prof. A.K. Pati, HRI, has been awarded the J. C. Bose Fellowship of the Department of Science and Technology this year (2019)

- Prof. Aditi Sen De, HRI, has been awarded the S.S. Bhatnagar Prize in Physical Sciences for 2018 for her contribution to Quantum Information and Communication Theory

- Prof. B. Mukhopadhyaya, HRI has been elected a Fellow of the Indian Academy of Sciences and Prof. Sumathi Rao has been appointed a Divisional Associate Editor at Physical Review Letters.

- NISER was awarded the India Research Excellence- Citation Award, 2019 by Clarivate Analytics. Since 2004 Clarivate Analytics has been presenting these awards to identify and recognize the most influential researchers and institutions for their outstanding and pioneering research contribution to the country.

- Dr. S. Varma, BARC, Dr. V. Jayaraman, IGCAR, Dr. G. Sugilal, BARC, Dr. S. Ghorui, BARC, Dr. D. Sen, BARC, all faculty of HBNI received the prestigiousHomi Bhabha Science and Technology award for the year 2018.

Dr. Jayaraman, IGCAR, receiving the
Homi Bhabha Science and Technology Award

Dr. P. Khare, RRCAT, receiving the
Homi Bhabha Science and Technology Award

Dr. Sugilal, BARC, receiving the
Homi Bhabha Science and Technology Award

Dr. D. Sen, BARC, receiving the
Homi Bhabha Science and Technology Award

Dr. S. Ghorui, BARC, receiving the
Homi Bhabha Science and Technology Award

Dr. S. Varma, BARC, receiving the
Homi Bhabha Science and Technology Award

- Dr. J.A. Mondal, BARC and Dr. H.S. Biswal, NISER figure in the list of young scientists whose paper was selected for the Young scientists virtual special issue of the Journal of Physical chemistry.

Dr. H.S. Biswal,
NISER

Dr. J.A. Mondal,
BARC

- Dr. C. Gunanathan, Associate Professor of School of Chemical Sciences, NISER has been chosen to receive the CRSI (Chemical Research Society of India) bronze medal for the year 2020.

- Dr Sayantani Bhattacharyya and Dr Ajaya K Nayak of School of Physical Sciences, NISER have become the Associates of the Indian Academy of Sciences.

- Prof. P.R. Vasudeva Rao, Vice Chancellor, HBNI, Prof. Gautam Menon, IMSc and Prof. R. Thangadurai, HRI have been elected as Fellows of National Academy of Sciences, Allahabad.

- Prof. SaibalBasu, Associate Dean, HBNI, has been selected as an Associate Editor of the Materials Science Section of Heliyon, an open access journal published by Elsevier.

- International Award for Former IPR Research Scholar
- Former research scholar of IPR, Dr.Rupak Mukherjee received the 2019 PPPL under-30 Doctoral Scientist / Student Award, in recognition of his exceptional contribution to

plasma physics at the start of his career. He has been a postdoctoral fellow at the Princeton Plasma Physics Laboratory (PPPL) since June 2019. The award was given based on his thesis work and publications in areas that describe the evolution of non-linear plasma flows. Dr. Mukherjee worked under Dr.Rajaraman Ganesh for his PhD at IPR. The award of $300 cash and a certificate and citation were presented to him at the 3rd Asia Pacific Conference on Plasma Physics (AAPPS-DPP) held in Hefei, China, during November 4-8, 2019.

- Mr. Arijit Sen and Ms. Kirti Atreyaof VECC ?have received best presenter and best poster award respectively in the International Conference on the Frontiers of Nuclear Physics held at Benaras Hindu University during 14-17th October, 2019.

Mr. Sen receiving best presenter award

Ms. Kirti receiving best poster award

NISER bags the India Research Excellence – Citation Award 2019

Clarivate Analytics, a global leader in trusted insights and analytics for research and innovation, announced the seventh edition of the India Research Excellence – Citation Awards in Sep. 2019. Since 2004, Clarivate Analytics has presented these awards to identify and recognize the most influential researchers and institutions for their outstanding and pioneering research contribution to the country.The awards are based on in-depth analysis conducted on data from the Web of Science citation index and InCites – a research performance and benchmarking tool. Highly cited research publications that imply high impact research published during the period 2012-2018 were an important criterion, among others, for the analysis.

NISER received the award in the category of Institutions established within 15 years.

Prof. Sudhakar Panda receiving the award from Prof. Ashutosh Sharma, Secretary, DST, at a function organized at Delhi

FORTHCOMING EVENTS

Foundation Day 2020

The Foundation Day of HBNI will be celebrated on 3rd June 2020. On this occasion, HBNI will be bestowing outstanding student awards to students selected from among those who received (a) Ph.D. or M.Tech. provisional degree, (b) MD, DM and MCh final degreefrom HBNI during the period 01 Jan 2019 – 31 Dec 2019. The nominations for awards can be forwarded by the Guide or any member of the Doctoral Committee. The nominations, with relevant documents, should reach Dean, HBNI not later than February 29, 2020. The nominations will be put up to the concerned Boards of Studies for selecting the best thesis. The award will consist of a cash award, medal and citation. (Details are available on HBNI website).

A few among the theses nominated for outstanding student award, which report innovative development will also be considered for J.B.Joshi Research Foundation Endowment awards. These awards will also be presented during the Foundation Day function.

All students and Faculty of HBNI are welcome to participate in the Foundation Day. We also welcome contributions to the Foundation Day issue of AnuVidya from students and faculty, in the forms of articles, poems or drawings in English and Hindi. The contributions may be forwarded to Editor@hbni.ac.in. We also solicit articles related to special events organized in the CIs/OCC, extension/outreach program and news items especially related to awards and honours received by faculty and studentsduring the period 01 Jan 2019 – 31 Dec 2019.

Seminar in Hindi on "Indian Scientific and Technological progress in the field of Energy"

The Official Language Implementation Committee, IGCAR is organising a two-day All India Hindi Scientific Seminar on 9th & 10th January, 2020 at IGCAR, Kalpakkam, on the above subject. Papers/Posters on the above mentioned topic are invited from the Officers/Employees/Researchers working in DAE Units, Scientific/Research Institutions, PSUs, Educational Institutions, for presentation in the technical sessions of the Seminar. There is no registration fee for participation in this Seminar.

National Arabidopsis Meeting at NISER

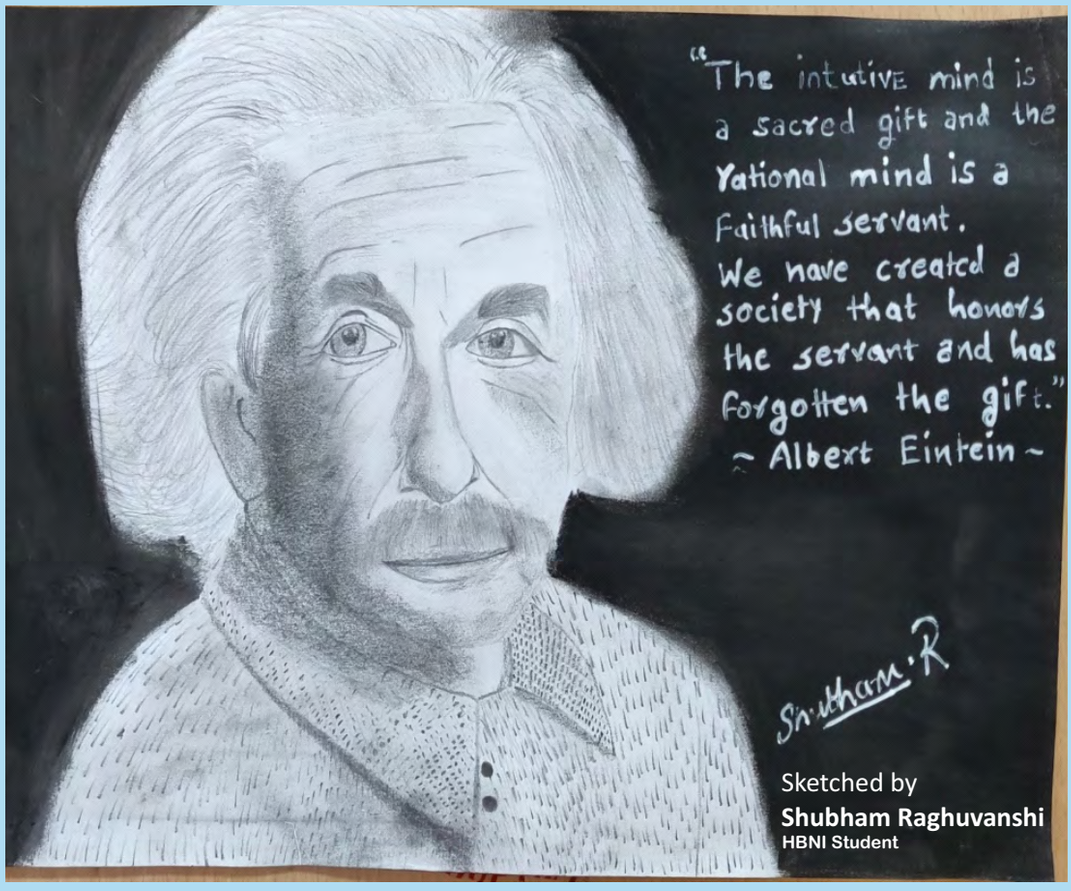
National Arabidopsis Meeting(NAM-2019) will be organizedby NISER during 29-31 December 2019. It will bring together eminent speakers and investigators who are at the forefront of different aspects of plant biology research. The conference is also open to scientists outside India.

National Symposium for Commemorating 30-years of ADITYA Tokamak, 27-28 January 2020

IPR will be organizing two-day National Symposium to commemorating the 30 years of the successful operation of the first indigenous Tokamak in India – "Aditya and its Upgrade". The main focus of the symposium would be current research activities as well as future scientific and technological road map obtained from the results of the "Aditya" as well as "Aditya Upgrade Tokamak" in terms of dedicated talks. The talks will cover wide are of tokamak research viz. Tokamak Basics: History, Principle, Design and Assembly Tokamak Operation: Working, Vacuum, Pulse power supplies, Electronics, Data acquisition, Diagnostics, RF pre-ionization, heating and current drive Plasma Physics and Nuclear Fusion: Theory, Simulation and Experimental Physics Studies

Sketched by
Sarita Ahlawat
HBNI Student

Sketched by
Shubham Raghuvanshi
HBNI Student



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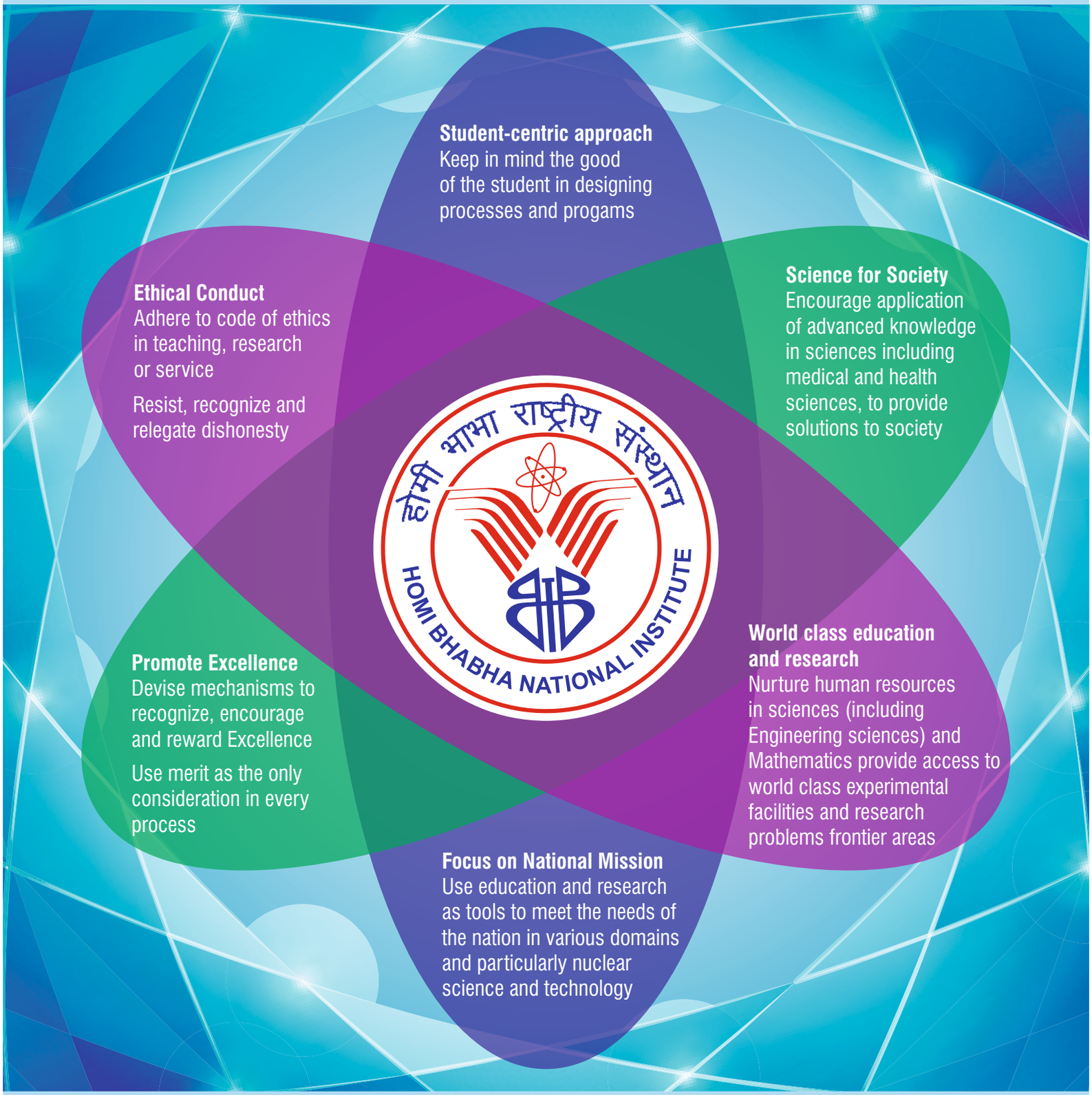
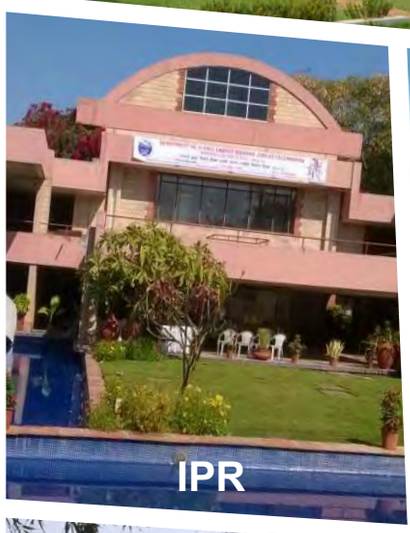
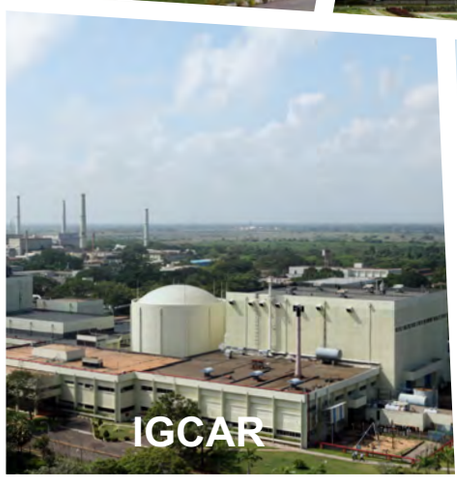
Shubham Raghuvanshi
HBNI Student

Core Values of Homi Bhabha National Institute







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ट्रेनिंग स्कूल परिसर
Training School Complex

अणुशक्तिनगर,मुंबई, भारत
Anushaktinagar, Mumbai, INDIA

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