

VECC NEWSLETTER

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ACCELERATOR

OPERATIONAL ACTIVITIES OF K130 ROOM TEMPERATURE CYCLOTRON

The K130 room temperature cyclotron has been operating round the clock and delivering light and heavy ion beams for various research activities from January, 2021 to June, 2021. During this period, the cyclotron has delivered both alpha and proton beams using the internal PIG ion source. These light ions have been used for the production of isotopes, radiation damage study, nuclear physics experiments etc.

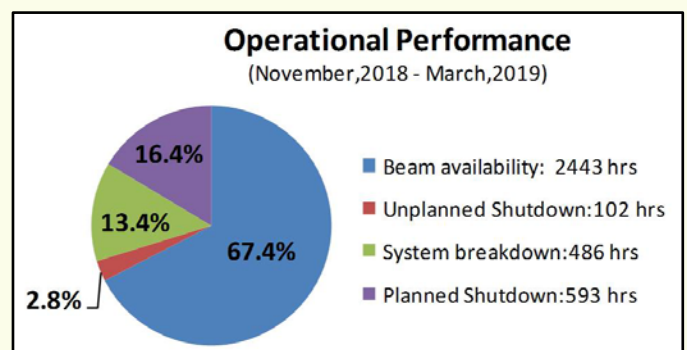
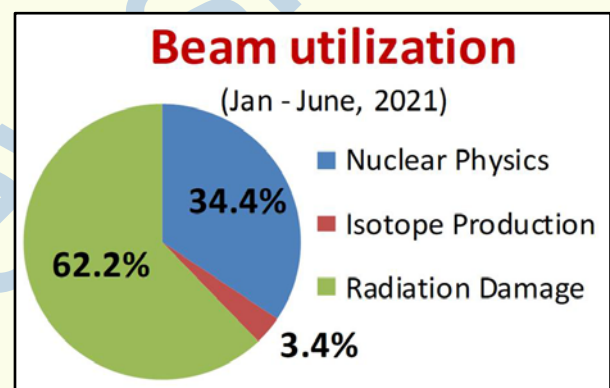
A planned shutdown of cyclotron was taken in the month of April, 2021 (about 10 days) for new puller assembly installation, target and dee probe work and in the month of May, 2021 (about 15 days) for computer control of puller assembly, LCW pump & cooing tower maintenance work. However, sub-systems of cyclotron were shut-down from middle of May to middle of June, 2021 due to state lockdown for COVID-19 pandemic. The cyclotron operation was also suspended in April, 2021 due to unplanned shutdown. This was due to water leaks in RF panels. Apart from these, the cyclotron operation was also interrupted due to power dips and trips, leak chasing, Faraday cup malfunctioning, vacuum problem, conditioning of deflector and RF system etc.

The cyclotron has delivered alpha ion at various beam energies @ 0.3 nA to 4 nA in channel # 2 and 3 and 200-500 nA in channel #1 as per user requirement. Proton beam of 7.5 MeV @ 3.5 μA to 3.8 μA was used on target in the channel#1 for more than 50 days with utmost stability and the experiment was successful.

During the above period, following ion beams have been utilized for the experimental purpose.

Projectile	Beam Energy (MeV)
Alpha	27, 28, 29, 30, 32, 32.7, 34, 35, 36, 39, 40, 42.7, 45, 46, 52
Proton	7.5

The facility has been utilized by the experimentalists of VECC, SINP, SSSIHL-Andhra Pradesh, UGC-DAE-CSR-KC etc. The beam utilization chart for the experiments (1742 hrs) of K130 cyclotron is shown below.



For further details please contact Shri P S Chakraborty (prodyut@vecc.gov.in), Head, Cyclotron Operation Section/APG.

DEVELOPMENT OF PROTOTYPE ION SOURCE POWER SUPPLIES FOR MC18 CYCLOTRON

With the available expertise on cyclotrons both for R&D and medical applications, VECC, Kolkata has taken up design and development of an 18 MeV Cyclotron, MC18, for production of radioisotopes. In this regard, Power Electronics & Magnet Coil Development Section has been developing prototype power supplies for the Ion Source of MC18. Consisting essentially of four power supplies viz., Filament, Arc, Suppressor and Puller power supplies floating on the high voltage potential of a fifth bias power supply, the major challenge was the design of the floating assembly of four power supplies of varied power ratings,

controlled from the ground potential with proper isolation as required (Fig. 1).

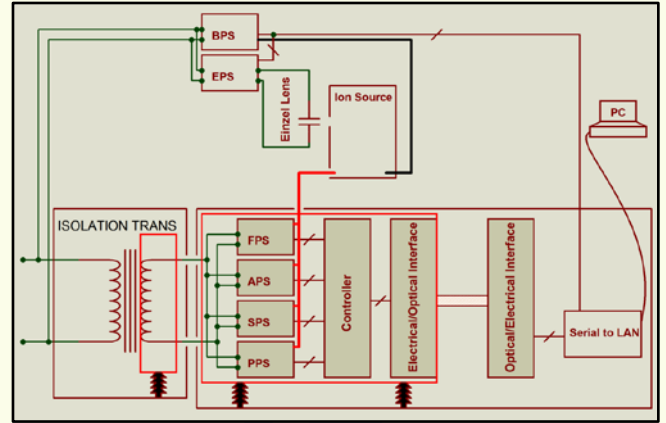


Figure 1 Basic scheme representing power supply and control wirings (red border demarcates the system floating on HV bias)

Table 1: Power Supply Ratings

Sl#	Power Supply Name	Rating	Regulation mode	Make
1	Bias Power Supply	-50 kV, 6 mA DC	Voltage/current	M/s Spellman
2	Filament Power Supply	12 V, 150 A DC	Current	Inhouse
3	Arc Power Supply	120 V, 15 A DC	Voltage	Inhouse
4	Suppressor Power Supply	10 V, 20 A DC	Voltage	Inhouse
5	Puller Power Supply	10 kV, 10 mA DC	Voltage	Inhouse
6	Einzel Lens Power Supply	-20 kV, 1.5 mA DC	Voltage	M/s Spellman

The ratings of the power supplies are tabulated in Table I. These four power supplies are to be floated on the -40 kV potential of the bias power supply. This necessitated a high voltage isolation transformer to isolate the mains and offer the required insulation to float the four power units. A 20 kVA/230 V 50 Hz 1:1 oil cooled isolation transformer with 200 kV isolation was utilized for the purpose. Another power supply for biasing the Einzel Lens completed the prototype assembly.

All the power supplies were supervised through remote PC based interfaces communicated through serial links. Optical fibre based communication modules were designed for isolation of the serial link between the modules floating at high voltage and that at ground level. Optical fibre wiring was also carried out for communicating the state of the external interlocks, viz., water flow, vacuum, etc.,

which will be at ground potential, to the power supplies floating at high voltage.

Switching techniques of various power supply topologies were explored and appropriately used for power conditioning of the different units.

All the floating units with their regulation and control modules were assembled in a high voltage rack with isolating bushings used for mounting and support.

PC based supervisory softwares were developed (Fig. 2) for the purpose of supervisory control and logging of selected parameters for all the 6 units. Two VB based consoles for the units at high voltage and two Python based consoles for the bias and Einzel Lens power supplies were developed to control the power modules remotely.



Figure 2 Screenshot of control PC during beam tuning showing beam and GUI of supervisory systems for power supply and beam monitoring

The indigenously developed power supplies were tested at their rated capacity on dummy resistors and were integrated to the actual load (Fig. 3).

For further information, please contact Dr. S. K. Thakur (thakur@vecc.gov.in), Head, Power Electronics & Magnet Coil Development Section, ATG

PHYSICS

EXPERIMENTAL CAMPAIGN WITH ALPHA BEAM FROM K-130 CYCLOTRON, USING GAMMA ARRAY OF COMPTON SUPPRESSED CLOVER AND LEPS HPGE DETECTORS

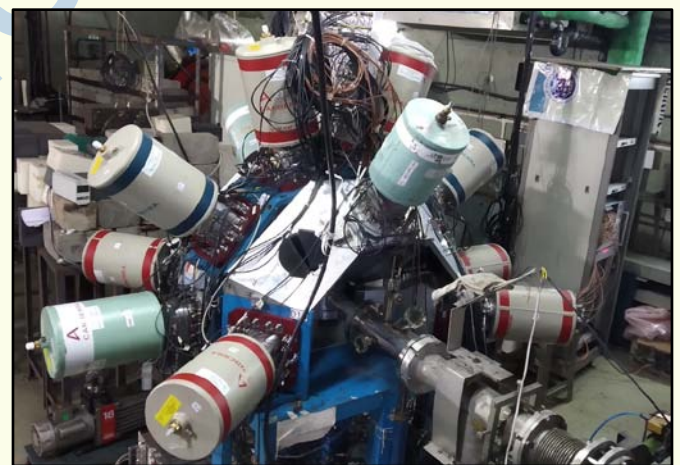
During the pandemic period of 2020-2021, an in-beam experimental campaign, using Alpha beam, was carried out at channel-3 beamline of K-130 cyclotron, under the collaboration of SINP, UGC-DAE CSR, and VECC, Kolkata. A large gamma detector array consisting of 11 Compton suppressed Clover HPGe detectors and 1 segmented LEPS (Low Energy Photon Spectrometer) was set up for the campaign. The detectors were contributed by the collaborating institutes and a digital data acquisition system from UGC-DAE CSR, Kolkata was used to process the detector signals and acquire the data.

The experiments addressed various physics issues related to nuclear structure studies of contemporary interests utilizing in-beam gamma spectroscopy techniques. Six experiments, proposed by various institutes and universities were performed. Alpha beams of energies in the range of 28-52 MeV were used for various experiments, as per requirement. Some of the important physics cases investigated



Figure 3 Power supplies during testing on dummy load

Tuned H⁻ beam of 50 μ A to 150 μ A were achieved using the system.



include, octupole correlation and signature splitting in nuclei of A~100-120 region, wobbling motion and neutron core excitation in heavier nuclei near A~200, interplay of single particle and collective excitations in lighter nuclei near A~50. In one of the experiments, Alpha beam was degraded down to 22 MeV, for the first time using degrader foils at the cyclotron vault.

With participation of PhD students, the campaign under restricted situation of pandemic period. was possible to run for about three months, even

TECHNOLOGY DEVELOPMENT

DIGITAL CURRENT INTEGRATOR

A Digital Current Integrator is developed in-house for measuring the ion beam current and integrating the current to provide total charge value. The instrument is designed to measure bipolar currents ranging from 50pA to 100µA with an accuracy of <0.5% (of reading) over five decades. Digital counters (32bits) are used for individual range to calculate the absolute value of total integrated charge. The integrated value is retained in internal EEPROM in case of power failure. The front panel of the instrument is comprised of digital and analog display, ON/OFF switch, push button and LED indications. The LCD display is used to show the measured current and integrated value of

charge. The analog meter is also used to display the current with range and polarity indications. The ON/OFF switch is provided to start / stop the integration (counting). The push button is for configuration of the instrument and resetting the integrated value of charge. The instrument is also equipped with remote configuration and monitoring through RS-232 based serial interface.

Salient features

Parameter	Values
Current Range	±50pA to ±100uA
Accuracy	±0.5% of reading (in LCD) ±2% of reading (on analog meter)
Charge Counts	32 bit (9.5 digits) for each range
Display	LCD + Analog both
Remote Monitoring	RS232 Interface



UTILITY SOFTWARE

MONITORING UTILITY FOR VECC IT SERVICES AND RESOURCES

Various IT services of VECC are developed, hosted and maintained in-house to facilitate the users in their day-to-day scientific and administrative activities. IT services like web, e-mail, dns, proxy, dhcp, database etc are mandated to run round the clock and hence, continuous monitoring of the hardware resources and applications which are providing services is of utmost importance for the IT administration of VECC. In view of this, an open-source software based (Zabbix) monitoring utility has been installed,

configured and deployed for monitoring the availability of critical IT services (http, smtp, dns, proxy etc.), observing the utilisation of various resources (CPU load, disk space, memory usage, bandwidth etc.) of IT servers and generating alerts on detection of any service or health-related fault. This system comprises a central server with a web-based graphical dashboard (Figure 1) which is configured to display status of various system and service parameters collected from target servers through multiple agents installed on them. This

utility helps in constant verification of responsiveness of services, determining the current health of the hardware resources and early detection

and alarming of any service related issues before users complain.

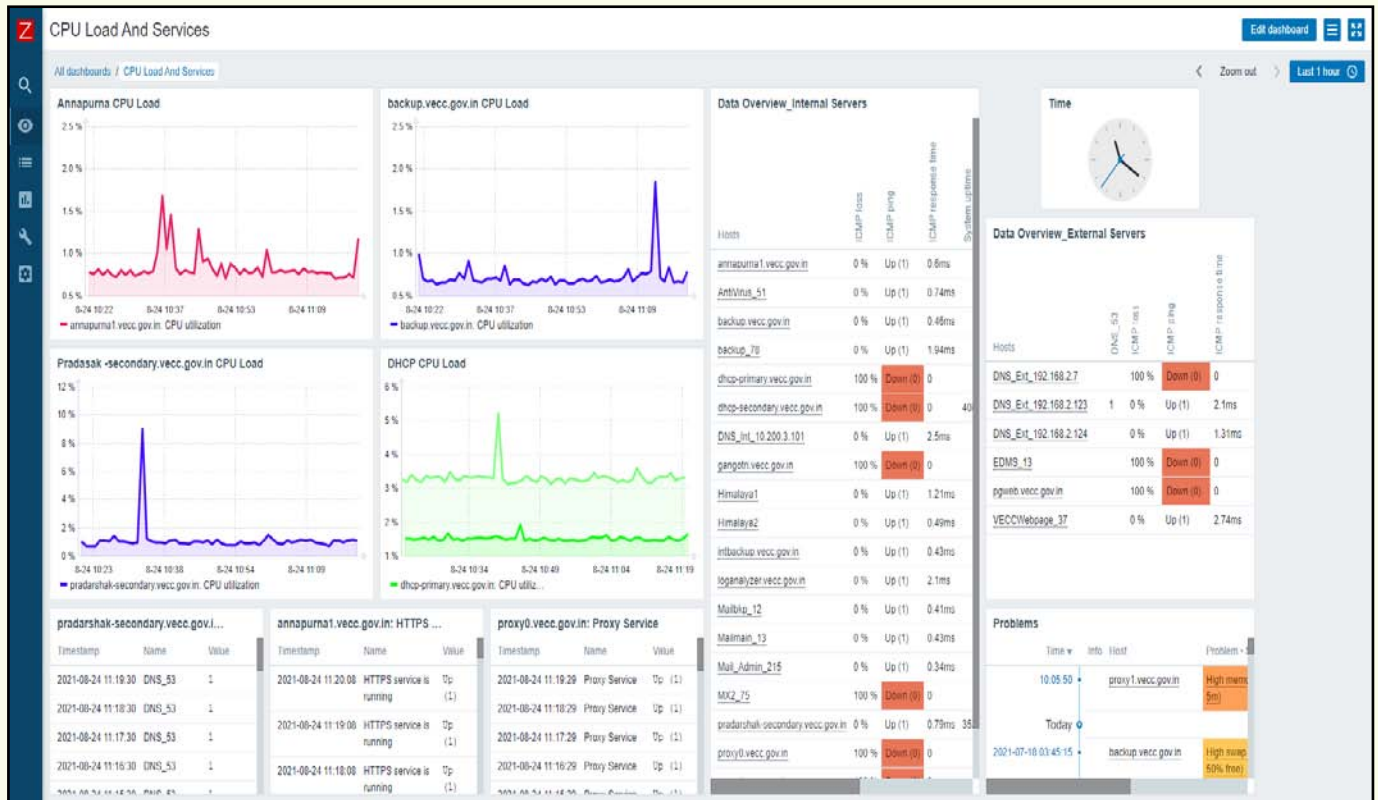


Figure 1: Web-based dashboard of the Monitoring Utility

ELECTRONIC DOCUMENT MANAGEMENT SYSTEM

An Electronic Document Management System (EDMS) has been developed and deployed using open-source tools called “SeedDMS” to systematically manage digital documents through defined workflow and centrally store them with proper access rights and version control. This organizes files and folder hierarchically, in a way similar to file systems and provide web-based user interface to upload any file (text, pdf, excel, image etc.) and add meta data such as author name, keywords, a description or any other additional attributes to that file. A file along with its meta data

forms a document which can be attached to other related documents, assigned with access rights and run through a defined work flow for review, approval, revision and release. Released documents can be preserved with its previous versions and retrieved through full text search. A suitable administration portal is provided for managing user & group, work flow, access control etc. One such utility has been deployed in ANUNET for BARC and VECC officials to store and manage engineering documents of Medical Cyclotron -18 (MC-18) project.

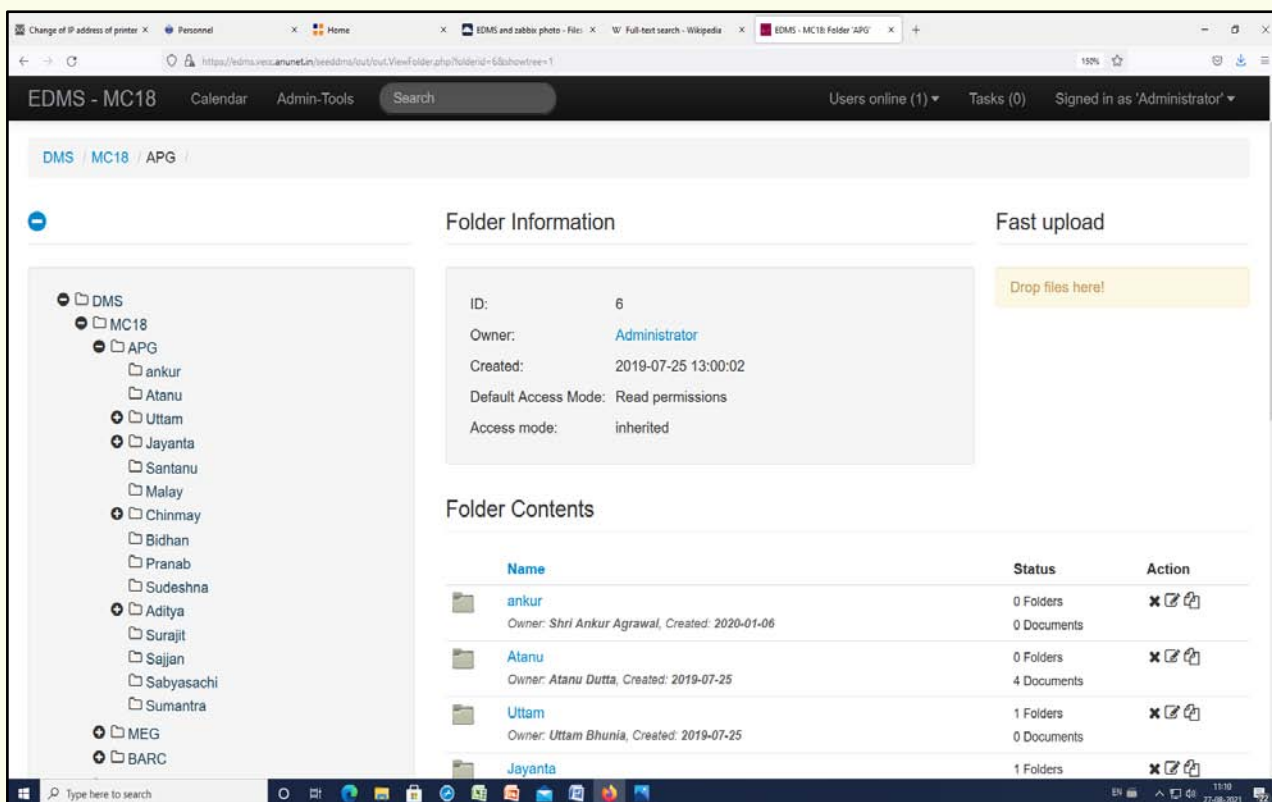


Figure 1: Web-based user interface of EDMS

HORTICULTURE

LANDSCAPING AT VECC

Years 2020 and 2021 have been difficult years because of the global pandemic and to add to this, natural calamities have hit our state hard, destroyed the natural flora and fauna. Our sprawling campuses too have not been spared by the two devastating cyclones. We have lost so many plants due to the cyclone Amphan. But the positive aspect is that we have been able to save some rare and valuable trees like the Purple Kanchan (*Bauhinia purpurea*) (Fig. 1), Teak (*Tectona grandis*), Fern tree (*Jakaranda mimosifolia*), Mango (*Mangifera indica*), Kadam (*Neolamarckia cadamba*), Acid lime (*Citrus aurantifolia*) etc. Seeing them blossom is sight for the sore eyes. We have already planted few trees in place of those which we could not save.

It gives us immense pleasure to state that on December 23, 2020, Director, VECC, Dr. Sumit Som planted one of the rarest Coconut varieties at MCF, Chakgaria named 'Gangabardhan' which gives fruits within three year of planting at a height



Figure 1: Purple Kanchan (*Bauhinia purpurea*) soaking in winter sun beside SCC building.

of just 3 feet. We have also planted world famous BARI Malta 1, Thai red and pink fleshed Jack Fruit, Jalpai, Apple Ber, Spices, Herbal plants as trial basis. Our VECC campus has been ornamented with floral decorations last winter (Fig. 2). Now P&G section has developed gardens at four campuses viz. Bidhan Nagar Campus; MCF, Chakgaria (Fig. 3); ANURIB, Rajarhat; Anushakti Abasan, Salt Lake. We have also developed a lawn prepared of *Cynodon dactylon* var. selection grasses beside Homi Jehangir Bhabha bust.



Figure 2: VECC campus has been ornamented with floral decoration during last winter.



Figure 3: Blooming paradise at MCF, Chakgaria campus.

An Immunity garden (Fig. 5) has been setup which includes various medicinal plants viz. Stevia, Guduchi, Bach, Tulsi, Ayapana, Pippali, Amlaki, Haritoki, Bahera, Neem, Arjun, Tejpat, Aswagandha etc. In the last couple of winters VECC campuses have been landscaped beautifully with various colors of nature like Marigold, Dahlia, Poppy, Petunia, Pansy, Aster, Phlox, Stock, Bougainvillea (Fig. 6), Gladiolus (Fig. 7), Chrysanthemum (Fig. 8), Lupin, Helichrysum Carpet Daisy, Tuberose var. Arka Prajwal, Calcutta Double and Antirrhinum

(Dog flower). We have already introduced 40 new varieties of rose, 25 standard chrysanthemum and 10 gladiolus varieties. We are taking initiative on hybridization programs and development of new varieties as well as budding and grafting procedures so that we can add something new and special to our campuses. We believe that gardening is not something which shows results in a day or even in one season, it's a life time work and we hope our continuous efforts will bring colors to our gardens and smiles on the face of the onlookers.



Figure 4: A 'peace' of green in front of Mahatma's statue beside VECC main building.



Figure 5: Immunity Garden beside VECC Stores.



Figure 6 Bougainvillea near Guest House.



Figure 7: Gladiolus near Maingate.



Figure 8 Chrysanthemum



Figure 9: Ever Lasting Straw flower.

“Flowers always make people better, happier and more helpful; they are sunshine, food and medicine to the soul.”– Luther Burbank

For further information, please contact Shri. Sourav Mondal (sourav.m@vecc.gov.in), Parks & Gardens, ATG

EVENTS

CDR DEFENSE OF GEM DETECTORS AND GAS SYSTEM FOR THE MUON CHAMBER (MUCH) SYSTEM OF CBM AT FAIR

Two review meetings teams of International experts were held for the Conceptual Design Reports (CDR) of Gas Electron Multiplier (GEM) based detector modules and the gas system for the Muon Chamber (MuCh) system of the CBM experiment at FAIR on 10th March and on 8th June 2021, respectively. The reviewing committee included experts on detectors in High energy physics experiments and gas systems. VECC is the main contributor to the first review and a major

contributor to the later one, in collaboration with PNPI-Russia. The day long review meetings included presentations on physics and simulation followed by detailed discussion on the system prototypes, test results, and final design configuration of the trapezoidal sectors of MuCh. Several questions were asked by the referees both in online and offline and were satisfactorily replied by the team members. This process is a major step forward in building the MuCh by the VECC team.

VECC CELEBRATES SWACHHTA PAKHWADA 2021

In order to execute the directives issued by DAE, Govt. of India, VECC Swachhta Committee took up several innovative jobs to observe Swachhta Pakhwada during 16th to 28th February, 2021.

The Green Expedition: On May 20, the eastern part of India especially Kolkata, West Bengal has witnessed the devastation created by the deadly tropical cyclone Amphan. More than 90% of the trees within VECC campus were damaged and uprooted by Amphan. During the Swachhta Pakhwada massive re greening initiatives were taken to restore the up-rooted trees along with an extensive tree plantation programme in VECC Campus.

Nationwide public awareness campaign: VECC Swachhta Committee conducted all India essay writing and drawing competition among the young stars of our country on the topics related to Swachhta during COVID pandemic. The participants submitted their drawings and essay (in either Hindi, English or Bengali) online. Results of the competitions were declared on valedictory function of Swachhta Pakhwada and the same was published online in VECC webpage. Number of participants was large and this awareness

programme created strong impact among the participants.

Inauguration of VECC Immunity Garden: VECC Swachhta Committee took an initiative to create awareness among the common people about immunity, immunodeficiency and auto immune disorders by inaugurating one Immunity Garden at VECC campus on February 26, 2021 Director VECC, in presence of Chairman Swachhta Committee and several dignitaries inaugurated the garden. The Garden has 18-20 varieties of medicinal plants with reported immunomodulatory action. A total 250 number of saplings were planted initially. In due course, the variety and number of plants will be increased.

Innovation in Swachhta: One 50 years old Mehagani tree was uprooted and died due to Super cyclone Amphan. VECC Swachhta Committee took an initiative to keep this VECC member alive for another 50 years by making one wooden sculpture out of this keeping in mind that the wooden statue should increase awareness about the conservation of forest and other natural resources. The mind-blowing statue was inaugurated by Director VECC.



Figure 1: Collage represents different events and activities conducted during Swachhta Pakhwada 2021

AWARDS & HONOURS

DAE YOUNG SCIENTIST AWARD-2019

Dr. Debasish Mondal has been conferred the Young Scientist Award for the year 2019 for his formidable contribution in experimental nuclear physics. He has experimentally determined the ratio of shear viscosity to entropy volume density for finite nuclear matter, which is the first of its kind measurement for atomic nucleus and addresses the broader question on the fluidity of strongly coupled systems. He has experimentally determined the isospin mixing probability in light mass system addressing the fundamental question of the significance of charge symmetry and charge independence breaking interactions in atomic nucleus. Apart from the aforementioned works of fundamental importance, he has made significant contributions in understanding the damping

mechanism of giant dipole resonance especially, in medium and light mass nuclei and its evolution with temperature and angular momentum. He has also made notable contribution in understanding exotic Jacobi shape transition and clustering in atomic nuclei.



YOUNG APPLIED SCIENTIST/TECHNOLOGIST AWARD 2019

Shri Vinod Singh Negi, of Experimental High Energy Physics and Applications (EHEP&A) Group, VECC, is conferred the DAE Young Applied Scientist/Technologist Award for the year 2019 for his contributions in the field of Radiation hard, low voltage power supply design and fabrication with fault tolerant control system against radiation-dependent errors. Shri Negi has tested each and every component of Low voltage power supply module including all the memory devices in Gamma radiation (up to 40 Krad) followed by Neutron irradiation (14 MeV, fluence upto 2.23×10^{12} N/cm²) at IUC-Kolkata and BARC-Mumbai, respectively. He has built a 15 channel Low voltage power supply

with error resilient control system for the GEM detector modules. The device developed by Mr. Negi has been tested successfully in harsh radiation environment at the mini-CBM experiment at GSI Germany.



DAE YOUNG ENGINEER AWARD 2019

Shri Shantonu Sahoo have been conferred DAE Young Engineer Award 2019 for his significant & outstanding contribution in the design and development of EPICS based distributed control system architecture for cyclotrons at VECC. His pioneering works on porting EPICS on ARM based embedded controller, development of multi-channel FPGA based Data Acquisition system for Superheated Emulsion Detector (SED) and SiPM based beam phase measurement system were some technological achievements. He developed Beam Current monitoring system, TrimCoil Power Supply (TCPS) control system and Beam Diagnostics system which are being extensively used by

cyclotron operators for optimal beam tuning. Shri Shantonu Sahoo has developed 3-Axis magnet characterization facility which is used for magnetic field mapping of many in-house magnets with high positional accuracy.



ANNOUNCEMENT

PUBLISHING OF A SCIENTIFIC BOOK FOR CHILDREN

A scientific story book, written by Dr. D. K. Srivastav, former director, VECC is translated by Shri Niraj Chaddha in Hindi. This book contains seven stories for children to enhance their curiosity in Mathematics, Science and Nature. It is intended

to reach out to more children who are conversant in vernacular language to give them a feel of science with the topics like number games, asteroids, stars and even dinosaurs in the form of stories in a simple language.

डा. दिनेश श्रीवास्तव FNASc, FNA
 प्राथमिक शिक्षा गृह तथा नवदिल्ली कलेजे से। 1966 में इलाहाबाद अकादमी तथा 1970 में इलाहाबाद विश्वविद्यालय से बीएस्सी, बी विद्या साधन। पत्नी डॉ. वरुणा कुंजरी विभाग के प्राथमिक विद्यालय में कार्यरत। 1971 में वैज्ञानिक के पद पर नियुक्ति। बर्क विश्वविद्यालय से 1979 में पी एच डी। 1979 में कोलकाता के परिवर्ती ऊर्जा साइकलोट्रॉन केंद्र में नियुक्ति, जहां से वह 30 जून, 2015 को केंद्र निदेशक एवं विभिन्न वैज्ञानिक के पद से सेवा-निवृत्त हुए। लगभग दो वर्षों के अतिथि वैज्ञानिक के पदों पर जर्मनी, अमेरिका तथा कनाडा में एच अणु-कार्य के लिए अटलेशन में रहे। समिति राष्ट्रीय प्रथम अकादमिक संस्थान, बंगलूर में होमी भाभा शेरार प्रोफेसर के पद पर कार्यरत।

अनुवादक
नीरज चड्ढा वैज्ञानिक-अभियंता
 जून, 1977 में इलाहाबाद (इलाहाबाद) के एक विज्ञान-संस्कृत परिवार में जन्म। प्राथमिक शिक्षा-पैसा हिन्दी तथा संस्कृत भाषा के माध्यम से। 2007 में इन्स्टीट्यूट ऑफ इन्जीनियर्स इंडिया, कोलकाता से स्नातक तथा 2018 में होमी भाभा राष्ट्रीय संस्थान, मुंबई से एच एच डी (इंजीनियरिंग) की शिक्षा। विभिन्न स्नातकोत्तर एवं डॉक्टरेट-पत्रिकाओं में सांख्यिक संख्या प्रकाशित। समिति परमाणु ऊर्जा विभाग के परिवर्ती ऊर्जा साइकलोट्रॉन केंद्र, कोलकाता में वैज्ञानिक अभियंता के पद पर कार्यरत।

... प्राकृतिक रूप से विज्ञान बच्चे अपने असीमित उत्साह और पूर्णतः मौलिक रूप में चीखों की असीम क्षमता के साथ, गिरती भी ऊपर उठती है अतः प्राकृतिक में, मास्टर में आसपास जिनके "छोटा" कर सकते हैं।
 "एक बार यदि बच्चे विज्ञान को जाते और उनके आश्चर्य का भाव पर जाते तो मनुष्य जाति को आगे बढ़ने से कोई नहीं रोक सकता।"
 "इस संकल्प को लागू करने की सुरक्षा छोटे बच्चों की इसी उत्सुकता को प्रेरित करने के लिए बनाई गयी है।"

शौर्य और माया के सात वैज्ञानिक कारनामे
डा. दिनेश श्रीवास्तव
अनुवादक नीरज चड्ढा

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